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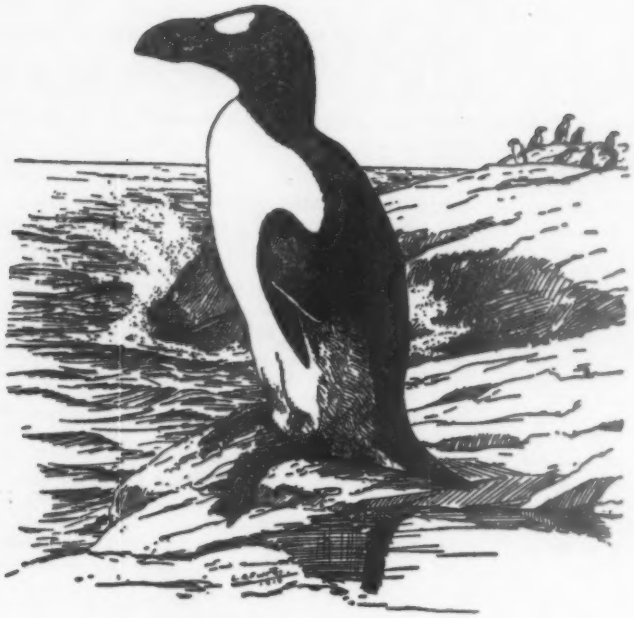

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POLYMORPHISM IN MEXICAN BROWN JAYS

BY ROBERT K. SELANDER

The systematic relationship of the Brown Jay *(Psilorhinus morio)* and the White-tipped Brown Jay *(P. mexicanus)* has been a topic for speculation by ornithologists visiting eastern México and those concerned with classification of the Corvidae (Amadon, 1944: 8). They have been carried as separate species in the literature by nearly all writers and are listed as such in the recent Mexican check-list (Miller, *et al.*, 1957), but from time to time in recent years the suggestion has been made that they are color phases or morphs of a single species.

Hellmayr (1934: 15) seems to have been the first to question the status of these jays and to suggest that "the so-called *P. mexicanus* . . . [is] a mutant of *P. morio* rather than a distinct taxonomic unit." More recently Sutton (1951: 233) and Amadon and Eckelberry (1955: 76) expressed belief that the two jays are color phases, and Eisenmann (1955: 74, and 1957: 256) also questioned their status. The principal recent advocates of the view that the two jays are specifically distinct are Wetmore (1943) and Lowery and Dalquest (1951).

The present study is based primarily on data obtained in eastern México in June and July, 1957. Early in this study it became apparent that discontinuous polymorphism, presumably genetic, was involved, and that the morphologically distinct types (Plate 14) which have been considered separate species are in fact color phases of a single species. Both types were found in the same brood, were constantly associated, and showed no differences in habitat selection or behavior.

Attention was then focused on the important problem of geographic variation in morph-frequency, with a view to mapping ratio-clines of the two morphs in Veracruz, Oaxaca, Tabasco, and Chiapas. Fifteen major study areas were visited from Tamaulipas south and east to Campeche, and censuses were made at over 25 localities. A total of 182 specimens of *Psilorhinus* was collected and prepared as study

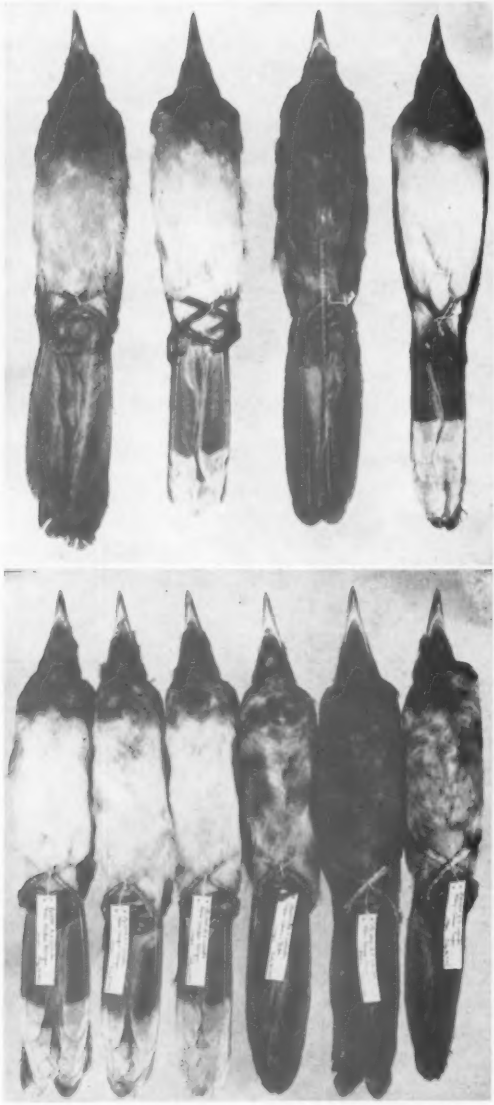
skins or skeletons; these have been deposited in the Museum of Vertebrate Zoology, Berkeley, California. Additional specimens were obtained on loan from museums. Some preliminary observations and collections of Mexican Brown Jays were made by the author in 1952, 1953, and 1954, and a hybrid between *Psilorhinus* and the Magpie Jay, *Calocitta,* from east-central Chiapas was studied by Pitelka, Selander, and Alvarez del Toro (1956).

FIGURE 1. Distribution of *Psilorhinus morio.*

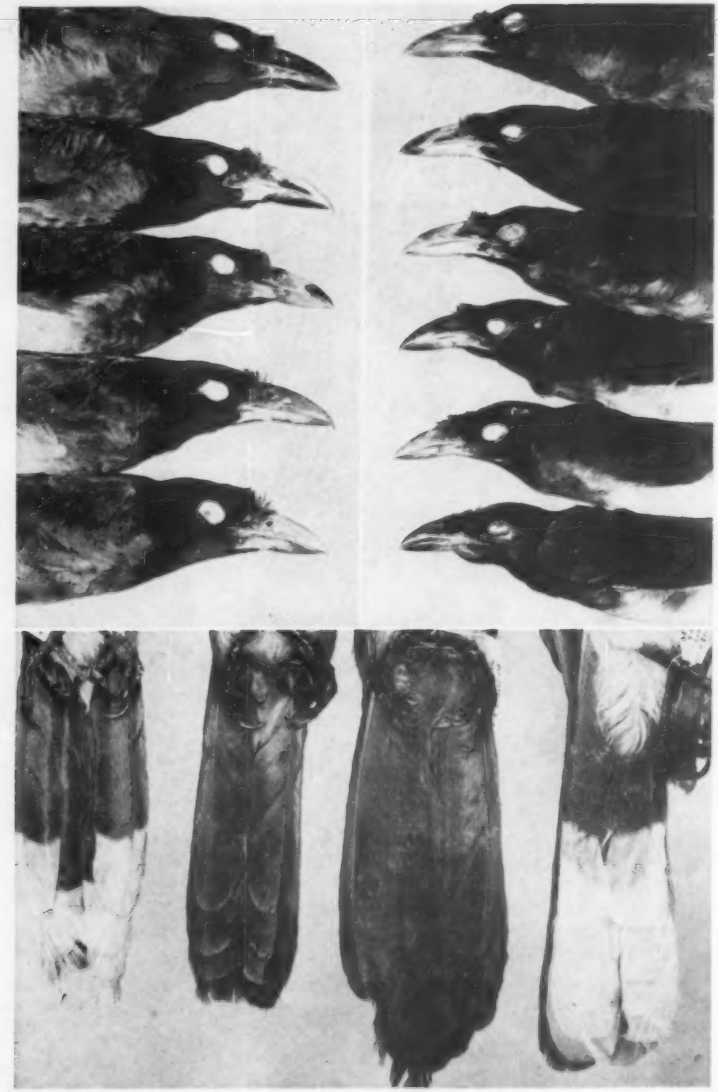
Throughout this report, "white-tipped morph" refers to the *"mexicanus"* phase, and "brown morph" is used for the *morio* type.

DESCRIPTIONS OF THE MORPHS

Brown jays are magpie-sized birds, measuring from 14 to 18 inches in length. Dorsally the two morphs are indistinguishable. The head and neck are dark sooty brown, grading to a lighter brown on the back, scapulars, rump, and upper tail coverts; dorsally the wings and tail are deep olive gray and usually have more or less of a bluish sheen. Ventrally the morphs differ conspicuously (Plate 14). In the brown morph the rectrices are uniformly brown; and the posterior



BROWN JAYS. *(Above)* Adult specimens showing color and pattern differences between morphs. From left to right: Male brown morph (Coatepec, Veracruz), female white-tipped morph (Catemaco, Veracruz), male brown (Teapa, Tabasco), male white-tipped (Palenque, Chiapas). *(Below)* Three juvenal white-tipped morphs from Palenque, Chiapas, and three brown morphs from Teapa, Tabasco. The second specimen from the right is a melanistic variant.



BROWN JAYS. Age and individual variation in color of bill. *(Left)* Adult males from central Veracruz (June-July). *(Right)* Juvenal males from Tabasco and Chiapas (July). *(Below)* Age variation in shape and size of rectrices. From left to right, two first-year and two adult female specimens.

under parts, including the under tail coverts and axillaries, range from brown to light grayish brown, the latter character being subject to a considerable degree of individual and geographic variation. In the white-tipped morph, rectrices 2 to 6 have conspicuous white-tips, but the central rectrices (1–1) are unmarked brown as in the brown morph. The posterior under parts of the white-tipped morph are cream white or white. In both morphs the breast is dark sooty brown, similar in shade to the back. A pale malar patch is indicated to some degree in all specimens, and occasionally it is well defined and grayish blue in color and there is an imperfectly developed light patch above the eye (Plate 15).

Juveniles are closely similar to adults in pattern (Plate 14), but the dark parts of the plumage are slightly paler. And in feather structure there is a conspicuous difference, the barbs being more widely spaced along the rhachis.

There is no appreciable sexual dimorphism in color or pattern, but females are significantly smaller than males in all dimensions.

The dark parts of the plumage fade rapidly with wear and exposure, so that only a few months after the fall molt the birds are brown rather than dark sooty brown. Prior to the time of the next fall molt the darker parts of the plumage may be grayish brown.

Age determination.—First-year birds may be distinguished from adults on the basis of a combination of criteria established for American jays by Pitelka (1945, 1958). The postjuvenal molt is incomplete, the juvenal rectrices, remiges, greater primary coverts, and a variable number of greater secondary coverts being retained. These differ in shape, structure, and, to some degree, in color from adult feathers (Plate 15). Also, they are at all times of the year more worn and faded than adult feathers, and even those feathers grown in the postjuvenal molt apparently are less resistant to wear and fading than are feathers of adult birds.

The importance of segregating age classes in systematic studies of Brown Jays is apparent from comparisons of measurements of adult and first-year individuals. Wing and tail average significantly shorter in first-year birds than in adults. Moreover, the data indicate that in this large species complete growth may not be attained by first-year birds undergoing their second fall (first postnuptial) molt. For example, 12- to 13-month-old first-year birds in postnuptial molt, collected in Veracruz in June and July, are smaller in length of bill and tarsus and weigh less than older birds.

The skull is completely ossified in all but a few first-year birds by June, at which time they are approximately one year old.

Color of soft parts.—Striking variability in coloration of the bill, tarsus, and toes is apparent in any representative series of *Psilorhinus* (Plate 15) and has been noted by many authors (*e.g.* Blake, 1953: 378). The color of the ring of skin surrounding the eye also is variable, as noted by Skutch (1935: 261), and a small patch of skin below the eye exhibits similar variation. These soft parts may be yellow, black, or parti-colored. My data on colors in birds of known age fully support Skutch's

claim, based on field observations, that these soft parts "turn black with age in an irregular fashion . . . taking two or more years to become entirely black."

In 1957, color and pattern of the soft parts were recorded for most specimens collected. These descriptions subsequently were grouped into categories of progressive development of black, permitting analysis of variation. Data on color pattern of the bill are summarized in table 1; age determinations are based on criteria described elsewhere.

According to Skutch (1935: 261), the nestling's bill, feet (tarsus and toes), and bill are uniformly yellow. Whether this is true of all nestlings is uncertain, but, in any event, in many juveniles the soft parts begin to darken very early. None of the juvenal specimens in table 1 was older than 3 months, and many, including some with partly black soft parts, had only recently fledged when collected and were no more than a month old. In fledged juveniles from one to three months old, the eye-ring is intense yellow, mustard yellow, black, or parti-colored yellow and black. Skin below the eye is yellow or greenish yellow; the tarsus, toes, and bill are yellow or parti-colored (Plate 15); the lining of the mouth is gray or flesh colored; and the iris is gray. Yellow of the soft parts varies from intense to dull grayish, and the tarsus and toes frequently have a greenish cast. The other extreme in coloration is seen in about 50 per cent of adult birds two or more years of age, in which the iris is solid brown, the mouth lining black, and the other soft parts uniformly black. In other adults and in first-year birds a seemingly unlimited variety of intermediate patterns is found (Plate 15). As regards bill, tarsus, and toes, there seem to be no regular patterns of replacement of yellow with black, although some trends are apparent from examination of large series of skins. Usually the iris is brown by the time a bird is one year old, but gray specks or patches may persist beyond the first year. Unlike the other soft parts, skin below the eye is never parti-colored; in intermediate condition it is gray-yellow.

There is a tendency for yellow to persist on the bill after other parts are uniformly black, but, even so, bill color (Table 1) serves as an index to stage of

TABLE 1

AGE, INDIVIDUAL, AND SEXUAL VARIATION IN COLOR OF BILL
(SPECIMENS FROM VERACRUZ, JUNE AND JULY, 1957)

			Per cent in various categories						
Sex and age	*Morph*	*No.*	*Yellow*	*Sub-yellow*	*¼ black*	*½ black*	*¾ black*	*Sub-black*	*Black*
♂ juvenile	Brown	15	33	27	13	27			
♀ juvenile	Brown	14	21	7	43	21	7		
♂ juvenile	White-tipped	3		33	33			33	
♀ juvenile	White-tipped	1	100						
Total juvenile		*33*	*27.3*	*18.2*	*27.3*	*21.2*	*3.0*	*3.0*	*0.0*
♂ first-year	Brown	3	33		33				33
♀ first-year	Brown	9	33	22	11		11	22	
♂ first-year	White-tipped	6	17	17	33		17	17	
♀ first-year	White-tipped	8	37		25	25			13
Total first-year		*26*	*30.8*	*11.5*	*23.1*	*7.7*	*7.7*	*11.5*	*7.7*
♂ adult	Brown	26	8	8		12	8	11	54
♀ adult	Brown	24			12		8	13	67
♂ adult	White-tipped	6		33		17			50
♀ adult	White-tipped	8			12	38			50
Total adult		*64*	*3.1*	*6.3*	*6.3*	*10.9*	*6.3*	*9.4*	*57.8*

development of black "adult" color of the soft parts generally. The categories in Table 1 are based on extent of black or yellow areas on the bill. All specimens were taken in Veracruz in June and July, 1957. The juveniles are from one to three months old; the first-year birds, all of which were in first postnuptial molt, are slightly older than one year; and the adults are at least two years old. Several points seem noteworthy.

Considerable individual variation is manifest in any one age or sex group; and while the majority of juveniles has the bill ¼ or less black, the bill of one specimen (collected on June 29) shows only a few small streaks of yellow ("sub-black"). Relatively little progress is made during the first year of life, since only 7.7 per cent of 26 year-old birds have all-black bills. The data suggest that in those individuals which as juveniles have bills ½ or more black, there is an increase in the area of black in their first year, whereas those with totally or predominantly yellow bills as juveniles do not progress. Thus, nearly equal percentages of juvenal and first-year birds fall in the "yellow," "sub-yellow," and "¼ black" categories, but a greater percentage of first-year than juvenal birds falls in the four more "advanced" categories. In two-year-old or older adults, 57.8 per cent have uniformly black bills, but a few (3.1 per cent) have totally yellow bills. Presumably a significant proportion of those adults having black soft parts are three or more years old. Age beyond the first postnuptial molt cannot be determined on the basis of presently known age criteria.

The data on bill color suggest, but do not prove, that progress is slightly more rapid in females than in males and in the brown morph than in the white-tipped morph. In adults, about 60 per cent of brown morphs, as compared to 50 per cent of white-tipped morphs, had uniformly black bills. This difference may not be significant because of the small size of the sample of the latter morph, but it is the kind of difference between morphs that may be expected, since morphic differences in plumage pattern, like the color changes of the soft parts, involve differential rates in deposition of black or brown (melanin) pigments.

Pitelka (1945: 256–258) has analyzed variation in changes in bill color from yellow to black in the jays *Aphelocoma unicolor* and *A. ultramarina*. In the latter species, "yellow color of the bill may disappear from the ages of slightly less than one year to more than two years." Of 216 specimens which were more than one year old, 49 per cent had some yellow on the lower mandible, suggesting a rate of change comparable to that of *Psilorhinus* in Veracruz. Unlike *Psilorhinus*, there is in *A. ultramarina* a tendency for males to acquire black bills before females.

Finally, it is obvious from the foregoing discussion that color of soft parts cannot be used as a criterion for age determination.

SURVEY OF EVIDENCE OF SPECIFIC STATUS

Before proceeding further it may be desirable to review and evaluate the arguments of authors claiming specific status for the two types of jays.

The only cogent argument that *morio* and *mexicanus* are species given by Wetmore (1943) is that the white-tipped type occurs without geographic variation "through the area inhabited by two . . . subspecies of *Psilorhinus morio*." This statement obviously was based on the assumption that the white-tipped morph occurs north to

Tamaulipas; but, as explained elsewhere, in fact it almost surely does not. The fact that the brown type "does not occur south of Chiapas, while two races of *mexicanus* extend through the area from Guatemala to the Almirante region in Panama" is cited as another line of evidence that two species are involved, but actually this circumstance has no particular bearing on the problem. Monomorphic geographic populations or races are frequently found in species which elsewhere have polymorphic populations (Ford, 1945; Huxley, 1943; for examples in birds, see Mayr, 1942, Mayr and Stresemann, 1950, and Huxley, 1955).

One of the arguments of Lowery and Dalquest (1951) is not directed to the point here in question: "Since in the Upper Tropical Life-zone of central Veracruz only *morio* was found, and since, along the Río Coatzacoalcos, in southern Veracruz, only *mexicanus* was found, and since in the intermediate area, the coastal plain, the two forms occur together but retain their specific distinctions, the two jays seem to be full species, *instead of only subspecies,* as some authors have suggested. [Italics mine]" I am not aware that it has been suggested that the two types are subspecies in southeastern México; the problem is whether they are species or morphs. Incidentally, the "intermediate area" where the two types occur together is not confined to the coastal plain of central Veracruz.

Lowery and Dalquest state that "In the breeding season . . . when the birds are mated, the pairs that were observed closely consisted always of individuals of the same type only." Unfortunately they do not give details as to the number of pairs observed and the frequencies of the two types of jays in areas where their observations were made; without such information it is, of course, impossible to judge the significance of their observations. In my experience these jays are almost invariably found not in pairs but in groups, often consisting of both types, even during the breeding season (see beyond).

In summary, no conclusive argument for considering the two jays as separate species rather than morphs has been presented. Their conspicuous differences in coloration and the fact that no intermediates are known have been the chief reasons for classifying them as species.

DISTRIBUTION

Psilorhinus occurs in eastern México and Central America from Tamaulipas and Nuevo León, in northeastern México, south and east to northwestern Panamá (Fig. 1); the distribution apparently is continuous. Brown Jays are permanent residents and are common if not

abundant over the greater part of their range. They are, in fact, the most conspicuous element of the avifauna in many areas.

Brown Jays are markedly eurytopic, being found regularly from sea level to 4700 feet and, locally, up to 6600 feet (as at Puerto de Diablo, San Luis Potosí), where they occur in nearly all open woodland or forest types, both deciduous and evergreen. In México, at least, highest population densities are found at elevations below about 2000 feet. They are absent from the depths of undisturbed, mature rain forest, although they invade disturbed stands and are commonly found along rain forest edges (Skutch, 1935: 261; Pitelka, *et al.*, 1956; Lowery and Dalquest, 1951: 617; Howell, 1957: 97).

In Central America and in the Yucatán Peninsula, all Brown Jays are the white-tipped type; populations are monomorphic (Fig. 1). The easternmost localities for the brown type are Montecristo, eastern Tabasco, and Palenque, northern Chiapas. In the region from eastern Tabasco north to central Veracruz, including adjacent parts of Oaxaca and Chiapas, both morphs are found in varying ratios, and it is here that their relationships may be determined (Fig. 2). North of latitude 19°25′ in central Veracruz, all jays are of the brown type.

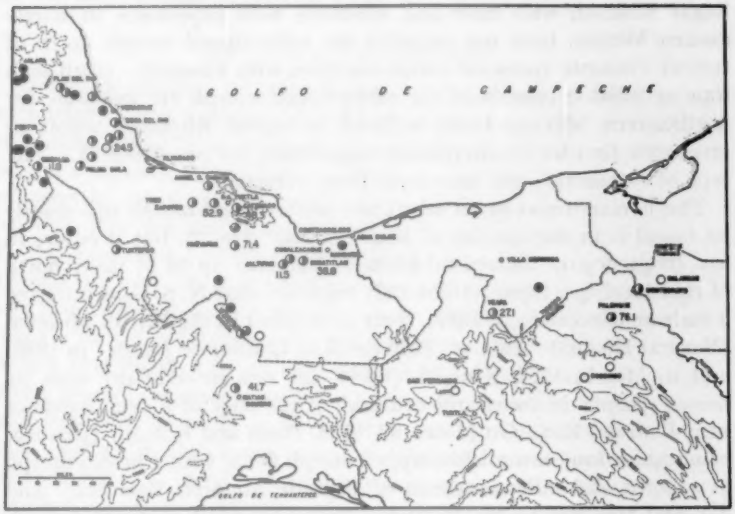


FIGURE 2. Distribution of *Psilorhinus morio* in central and southern Veracruz and adjacent areas. Dots represent records of the brown morph; circles, white-tipped morph; half-black symbols, both morphs from same locality. Numbers indicate percentages of white-tipped morphs in samples.

Northern limit of distribution of the white-tipped morph.—The northern limit of distribution of the white-tipped morph has been a matter of dispute and a source of misunderstanding. The fact that the type of *Psilorhinus mexicanus* Rüppell (1837) reportedly came from Tamaulipas ("Tamalipas") has been the basis for statements by some authors that the white-tipped morph occurs throughout the area occupied by two "races" of *morio (P. m. morio* and *P. m. fuliginosus).* But the occurrence of the white-tipped morph in Tamaulipas, or elsewhere in northeastern México north of central Veracruz, has never been confirmed. The Salvin and Godman (1887: 506) report of specimens of the white-tipped morph being obtained by Couch at Boquilla and China, Nuevo León, is simply erroneous. The specimens, which I have examined, are the brown morph (see also Ridgway, 1904: 300).

I have failed to record the white-tipped morph north of the coastal plain of central Veracruz. Hellmayr (1934: 15–16) questioned its occurrence in Tamaulipas, and Sutton (1951: 233) noted that: "In Tamaulipas, Nuevo León, and southeastern San Luis Potosí, I have seen literally hundreds of 'true' Brown Jays [brown morph], but not a single 'white-tipped' bird." Similarly, Mr. Irby Davis and Mr. Edgar Kincaid, who have had extensive field experience in northeastern México, have not recorded the white-tipped morph north of central Veracruz (personal communication with Kincaid). Until such time as reliable records of the white-tipped morph are available for northeastern México, I am inclined to regard Rüppell's report as erroneous (but for an alternative explanation, see pp. 406–407). The type of *mexicanus* may have come from Veracruz.

The northernmost point where the white-tipped morph can readily be found is in the vicinity of Boca del Río (Fig. 2), but it occurs in low frequency on the coastal plain of Veracruz up to 30 miles north of that locality. Lantz (1899: 222) reported that N. S. Goss collected a male at Rinconada in 1887; there is an adult in the British Museum (Natural History) taken at "Plan del Rio, Canton de Jalapa" in 1886; and in March, 1954, Kincaid (1954) saw one in company with six brown morphs in "semi-arid country" at the edge of a deep barranca near Plan del Río. On March 30, 1955, Davis and Kincaid (personal communication) saw a white-tipped morph flying with a brown morph at a point 53.6 miles southeast of Vega de Alatorre, Veracruz. And Mr. and Mrs. Ben Coffey (personal communication) recorded a white-tipped bird in this same area on May 30, 1951.

Lowery and Dalquest (1951: 617) reported a specimen of *mexicanus* taken 5 kilometers east-northeast of El Jobo, 600 feet, Veracruz, on October 19, 1947. El

Jobo is a village on the road from Teziutlán, Puebla, to the Gulf of México (Lowery and Dalquest, *op. cit.*: 542). This is about 55 miles northwest of the next northernmost locality for the white-tipped morph, Plan del Río, Veracruz. In response to an inquiry concerning this specimen, I received the following comments from Mr. Phillip W. Ogilvie, Acting Curator of Ornithology, Kansas Museum of Natural History: "The skeleton of *P. mexicanus* [K.U.No. 24966] . . . is not mentioned in Dalquest's itinerary nor in his species account. In his field catalog of specimens the bird is referred to as 'Brown Jay (black-tail).' I regret to say that this specimen seems to be missing. It may be of some help to know that this skeleton was reidentified in the museum systematic catalog . . . as *P. morio morio*. I find no initials by this reidentification and therefore cannot tell you on whose authority it was made." Unfortunately, the specimen from near El Jobo is a skeleton (male) and its identification could not be verified even if it were located, but it seems clear from Dalquest's notes that it represented the brown morph, not *mexicanus* as reported.

Old literature records of the white-tipped morph at "Jalalpa," Veracruz (Cabanis, 1851, and a specimen in the British Museum (Natural History) from "Coatepec," in 1888) can, I believe, be discounted. This morph occurs on the coastal plain east of Jalapa, but there are no recent or reliable records of its presence in the vicinity of Jalapa or Coatepec, localities which have been rather extensively worked by ornithologists (Chapman, 1898; W. B. Davis, 1945; Lowery and Dalquest, 1951; Chester C. Lamb, in conversation; Selander, MS). Much the same may be said for old records of the white-tipped morph at "Mirador," Veracruz (Baird, *et al.*, 1875: 304–305; and a specimen collected by Nelson and Goldman in 1894).

Evidence of Polymorphism

Irrefutable evidence of polymorphism is the finding of the different morphologic types regularly mated and producing progeny. In most birds this would be a relatively simple matter, but in *Psilorhinus* there is a series of complicating factors: (1) Brown Jays are secretive and wary in the vicinity of their nests and, hence, difficult to study, although they are extremely conspicuous and aggressive elsewhere; (2) the sexes cannot be distinguished in the field except by differences in behavior; and (3) first-year birds remain with their parents during their first year and longer, assisting them, as "helpers-at-the-nest," in raising a brood or broods in the following year (Skutch, 1935). The result is that Brown Jays are rarely found in isolated pairs even in the nesting season. Almost invariably they occur in small flocks, sometimes consisting of birds of three age groups, juvenal, first-year, and adult. Each "family" tends to remain distinct from others until the juveniles are well grown, but groups may readily join others when disturbed, as when a collector attempts to obtain all members of a group! Their occurrence in flocks is mentioned by many authors, for example, Wetmore (1943: 297), who found them "in little groups of 3 or 4 to 10" at Tres Zapotes, Veracruz.

Composition of groups.—At all nests watched by Skutch in Central America, he found at least one helper; and he mentioned one nest attended by a pair and five helpers, a situation which is not at all uncommon to judge from my experience with post-breeding groups in México. As Skutch's observations were made in Central America (Sierra de Merendón, between Guatemala and Honduras), where only the white-tipped jay occurs, they provide no evidence pertinent to the problem of relationship of the color types.

Skutch (1935: 265) reported that the helpers "seem in most cases to be yearling birds who will not have nests of their own until they are two years old." He also suggested that not all helpers are offspring of the mated pair in whose duties they assist, for the number of helpers in one group may exceed the clutch size. Skutch's claim that the helpers are first-year individuals was based on his observations that in breeding individuals the feet and bill average blacker than in non-breeding birds which assist them. My data on composition of groups, obtained by collecting some or all members, fully support Skutch's statements regarding age and reproductive status of the helpers. Because the young were fledging or had already fledged at the time of my arrival in México in June, 1957, I could not study birds at the nest. I was able to determine which two individuals of a given group were paired only by collecting most or all members of the group and examining them for evidence of breeding. However, even when watching birds at nests, it is difficult to identify the male parent with certainty, since the helpers, as well as the mated male, assist in nest building, bring food to the incubating female, and feed the young (Skutch, 1935: 95).

None of the first-year females had brood patches, and their ovaries were granular, whereas adult females invariably had brood patches and ovaries which contained larger follicles; the latter were termed "post-active." A brood patch is not present in males. The testes of first-year males apparently undergo some enlargement during the breeding season, but they are on the average smaller than those of adults. No more than one adult male and one adult female were collected from any group.

In Table 2 the composition of several family groups from the Boca del Río and Lake Catemaco regions is shown. I have selected from my records those cases in which I am confident that all birds collected or seen belonged to a single family group.

Numerous groups composed of both morphs were seen but not collected. Some examples follow: Lake Catemaco, June 23, 2 juvenal brown and 2 juvenal white-tipped birds together with a white-tipped morph having black soft parts (adult?) and a white-tipped individual

TABLE 2

COMPOSITION OF FAMILY GROUPS FROM BOCA DEL RÍO AND LAKE CATEMACO, VERACRUZ

Group and date	*Sex and age*	*Morph*	*Color of legs and feet*	*Color of bill*	*Cranium*[1]	*Length of testis (mm.)*	*Ovary*	*Brood-patch*	*Probable status in group*
1	♂ ad.	B	B	B	CO	17	—	—	Male parent
June 12	♀ ad.	B	B	B	CO	—	Postactive	+	Female parent
	♂ 1 y	WT	¾ B	¼ B	CO	5	—	—	Helper
	♀ jv.	B	¼ B	¼ B	NCO	—	Inactive	—	Juvenile
	Other members of group not collected: one brown morph of undetermined age.								
2	♂ ad.	B	B	B	CO	"large"[2]	—	—	Male parent
June 12	♀ ad.	B	B	B	CO	—	Postactive	+	Female parent
	Other members: juvenal white-tipped morph and a brown morph and a white-tipped morph of undetermined age.								
3	♀ 1 y	B	¼ B	¼ B	CO	—	Inactive	—	Helper
June 14	♀ jv.	B	SY	SY	NCO	—	Inactive	—	Juvenile
	Other members: one white-tipped morph and 3 or 4 brown morphs of undetermined age.								
4	♂ ad.	B	?	?	CO	10	—	—	Male parent
June 14	♀ ad.	B	B	B	CO	—	Postactive	+	Female parent
	♂ 1 y	B	B	B	CO	?	—	—	Helper
	♀ 1 y	WT	½ B	½ B	NCO	—	Inactive	—	Helper
	? jv.	B	Y	Y	NCO	—	—	—	Juvenile
	? jv.	B	Y	Y	NCO	—	—	—	Juvenile
	♂ jv.	B	Y	Y	NCO	3	—	—	Juvenile
	♂ jv.	B	Y	Y	NCO	3	—	—	Juvenile
	Other members: none.								
5	♀ ad.	WT	B	B	CO	—	Postactive	+	Female parent
June 15	♂ jv.	B	Y	Y	NCO	3	—	—	Juvenile
	♀ jv.	B	Y	SY	NCO	—	Inactive	—	Juvenile
	Other members: one juvenal brown morph and one brown morph with black soft parts, possibly the male parent.								

TABLE 2 *(continued)*

COMPOSITION OF FAMILY GROUPS FROM BOCA DEL RÍO AND LAKE CATEMACO, VERACRUZ

Group and date	*Sex and age*	*Morph*	*Color of legs and feet*	*Color of bill*	*Cranium*[1]	*Length of testis (mm.)*	*Ovary*	*Brood-patch*	*Probable status in group*
6	♀ ad.	B	B	B	CO	—	Postactive	+	Female parent
June 26	♀ 1 y	B	Y	SY	CO	—	Inactive	—	Helper
	♂ jv.	WT	SY	SY	NCO	3	—	—	Juvenile
	♀ jv.	B	SY	Y	NCO	—	Inactive	—	Juvenile
	♂? jv.	B	SY	SY	NCO	?	—	—	Juvenile
	♂ jv.	B	Y	Y	NCO	3	—	—	Juvenile
	Other members: two birds of undetermined morph-type and age.								
7	♀ ad.	WT	B	B	CO	—	Postactive	?	Female parent
June 28	♀ 1 y	B	SY	Y	NCO	—	Inactive	—	Helper
	♂ jv.	B	½ B	½ B	NCO	4	—	—	Juvenile
	♀ jv.	B	Y	SY	NCO	—	Inactive	—	Juvenile
	Other members: two or three birds of undetermined morph-type and age.								
8	♂ ad.	B	B	B	CO	7	—	—	Male parent
June 28	♀ ad.	WT	½ B	½ B	CO	—	?	+	Female parent
	♀ 1 y	B	Y	SY	CO	—	Inactive	—	Helper
	Other members: none.								

[1] CO = completely ossified; NCO = not completely ossified.
[2] Testes demolished by shot.

with large yellow areas on the bill (first-year?); near Minatitlán, July 1, 5 brown and 1 white-tipped; 8 miles north of Matías Romero, July 10, 5 brown (including at least 1 juvenile) and 1 white-tipped; 10 miles north of Matías Romero, July 11, 1 adult (?) brown and 1 adult or first-year white-tipped with 2 juvenal brown; Angel R. Cabada, July 26, 6 brown and 2 white-tipped; Paso del Toro, July 26, 1 adult (?) brown with a white-tipped juvenile.

Older individuals were seen feeding juveniles of dissimilar morph-type on several occasions, as follows: San Andrés Tuxtla, June 23, juvenal white-tipped morph fed by an adult (?) brown; Minatitlán, July 2, juvenal white-tipped bird fed by first-year (?) brown; 10 miles north of Matías Romero, July 11, adult (?) white-tipped bird fed a juvenal brown; Tapalpa, near Santiago Tuxtla, July 26, adult (?) brown fed a juvenal white-tipped bird.

In June, family groups were more or less localized, being found in the same stands of trees on different days. By the first week in July, larger groups were forming and apparently wandering to a greater degree.

The data on composition of groups do not provide conclusive evidence as to the mode of inheritance of color differences. To solve this problem, cases in which similarly colored birds mate to produce offspring of the other morphic type or both types are needed. The association of a juvenal white-tipped morph with a post-breeding adult female brown morph and an adult male brown morph in group 2 strongly suggests that brown is dominant. It would be conclusive evidence were it not for the fact that the group included a white-tipped morph of undetermined age. It is possible, although improbable, that this bird was the male parent. If in fact the adult male and female pairs in groups 1 and 4 are the parents of the white-tipped first-year birds in their respective groups, brown is dominant to the white-tipped phase. However, as mentioned previously, there is some evidence that helpers may be associated with family groups other than their own.

Behavior.—As regards behavior, I found no difference between the morphs. Wetmore (1943) was equally impressed with their similarity, noting that "Possibly there are slight differences in note and habit between the two species of jays found at Tres Zapotes, but if so my period of observation in 1939 was not sufficient to allow me to detect them. It appeared at times that *morio* produced a louder snapping noise . . . but of this I was not certain. Both seemed equally inquisitive and vociferous, and both ranged through the same areas." I was unable to confirm Wetmore's suggested difference. The calls of the

two morphs were compared in the field, recorded on tape, and subsequently compared again. They are identical.

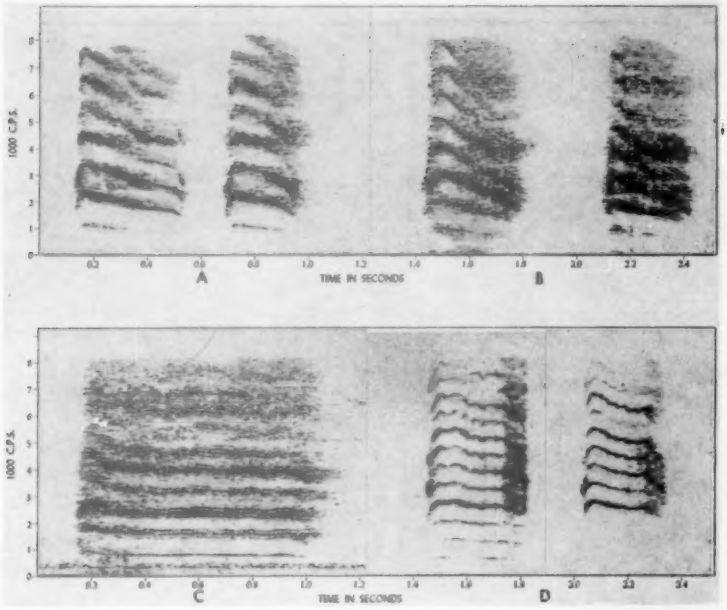
Wetmore noted that the furcular sac or pouch (a diverticulum of the interclavicular air-sac, see Sutton and Gilbert, 1942) of one of his specimens of the brown type "was a little smaller than those of the individuals of the other species examined and the sac seemed a little thicker walled." He was apparently correct in supposing that this represented individual variation, for I found no difference in structure of the pouch in the two morphs. There is, however, some age variation in structure. In juveniles the pouch itself is not firmly fused to the integument and may be pulled away with comparative ease, whereas in first-year and adult specimens, it cannot be separated from the integument.

The Brown Jay seems not to have a great variety of different calls. A characteristic call is a loud, low *pay-ah,* which is delivered repeatedly by members of groups as they move through the trees. As the birds become apprehensive at the approach of a human, or when they are "mobbing" a hawk, the *pay-ah* is gradually modified to a loud scream which is higher-pitched and more strongly accented (Plate 16). This has an obvious warning function. Sudden expansion of the furcular pouch as the call begins produces a low *pop,* which gives an almost explosive accent to the *pay* part of the call. The *pop* is not clearly audible at a distance and does not show well in sound spectrographs. Popping noises are sometimes made without the call, but their primary function is undoubtedly that of accenting the call. As a disturbed bird flies from a potential source of danger, the *pay-ah* calls rise in pitch and are given without the accenting *pop;* they are also given more rapidly. Once the warning call is sounded, all birds leave the immediate area. When scolding at low intensity, the *pay-ah* call may be extended in length to almost a full second (Plate 16).

The jays also make soft foraging notes that are difficult to describe, but which are unlike the usual ringing flock calls. Juveniles have a distinctive, short *hew* note and also call as do older birds, but more softly and at a higher pitch. They apparently do not scream or accent their calls with popping sounds, and their *pay-ah* note is often rendered *pay-ah-ah.*

The vocalizations of birds at Campeche were notably higher-pitched than those of birds heard elsewhere in México. This is correlated with their markedly smaller body size.

Size comparisons.—When specimens from any one region are segregated with respect to sex and age, there are no differences in size between the two color types. In Tabasco and Chiapas, both types are smaller than farther north (see Fig. 3). These facts have bearing on the problem of the relationship of the two color types and strongly support other lines of evidence indicating polymorphism. The prob-



SOUND SPECTROGRAPHS OF JAY CALLS. Calls of Brown Jay, *Psilorhinus*, recorded at Boca del Río, Veracruz, México: A, Two *pay-ah* calls of brown morph; B, Same call, white-tipped morph; C, Long version of call of brown morph. D, For comparison: Two calls of Blue Jay, *Cyanocitta cristata*, from Austin, Texas.

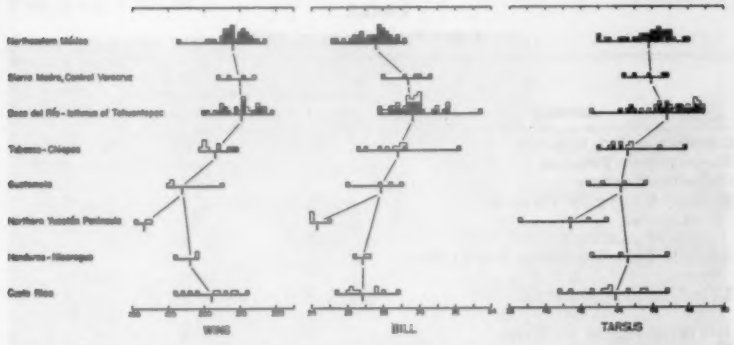


FIGURE 3. Individual and geographic variation in size in *Psilorhinus morio*. Black squares represent brown morph; open squares, white-tipped morph. Geographic contact between populations is indicated by narrow line connecting sample means. Measurements in millimeters.

ability of two species of identical size existing for any length of time in the same area without differences in habitat occurrence or feeding habits is remote. That two such species would vary geographically in precisely parallel fashion is equally improbable.

Molt.—All first-year and adult specimens taken in June and July were in fall molt, and careful comparisons of molt progress in specimens of the two morphs failed to reveal any significant difference.

MORPH-FREQUENCY AND RATIO-CLINES

Only a few authors have mentioned the relative frequency of the two morphs in particular areas, and no actual counts have been available for any locality within the range of the polymorphic population. During the summer of 1957, I made censuses in 13 different areas in eastern México from central Veracruz south to Palenque, Chiapas; these data are summarized in Table 3. Additional counts were made in northeastern México north of Veracruz and in Campeche. The data were obtained by recording all identified birds seen and/or collected at each locality. Any bias existing in these counts is in favor of the brown morph, since they were made at a time of the year when the tail feathers and other parts of the plumage were badly worn in many individuals. Thus, it is possible that some extremely worn white-tipped birds were mistakenly identified in the field as the brown morph. Counts made in fall or winter perhaps would be more accurate.

TABLE 3

MORPH-FREQUENCIES IN 1957

Locality	*Total number seen and/or collected*	*Per cent white-tipped morph*	*Period*
Coatepec region, Veracruz	35	0.0	June 7–9
Fortín region, Veracruz	36	0.0	July 27–29
Omealca, Veracruz	17	11.8	June 16
Boca del Río region, Veracruz	143	24.5	June 9–15
Riparian	111	19.8	
Coyol woodland[1]	32	40.6	
Angel R. Cabada-Santiago Tuxtla, Veracruz	17	52.9	July 26
Lake Catemaco, Veracruz	149	48.3	June 23–30
			July 6–7, 26
Hueyapan region, Veracruz	14	71.4	July 7–8
Minatitlán, Veracruz	31	38.8	July 1–3
Jáltipan-Coatzacoalcos region, Veracruz	26	11.5	July 3–5
Matías Romero region, Oaxaca	48	41.7	July 10–12
Teapa, Tabasco	48	27.1	July 15–17
Palenque, Chiapas	46	76.1	July 18–22

[1] 12 miles south of Boca del Río.

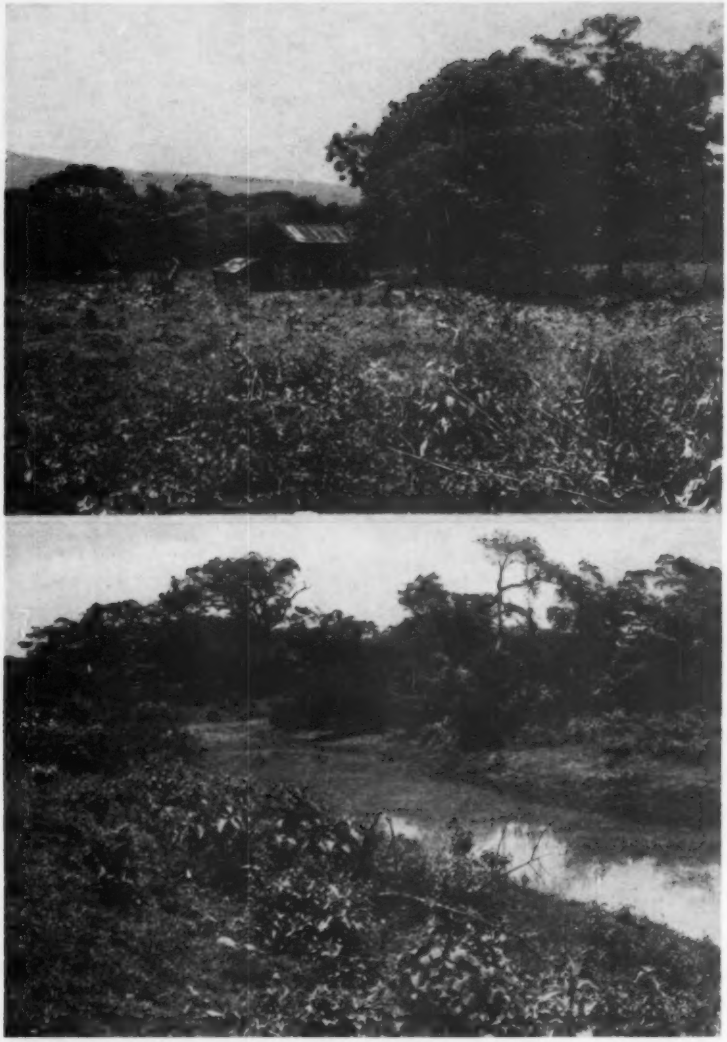
Fortín de las Flores-Boca del Río ratio-cline.—The population of *Psilorhinus* in the coffee zone of the Humid Upper Tropical Zone of the Fortín de las Flores-Córdoba region in west-central Veracruz is monomorphic brown. These localities are 3000 to 3500 feet in elevation in a region having an annual rainfall of 2270 millimeters, with no well-defined dry season (Contreras Arias, 1942). East of Córdoba the land slopes off to about 1330 feet at San Juan de la Punta (Cuitláhuac), which locality marks the division between the Humid Upper Tropical and Arid Lower Tropical zones; the latter zone extends to Boca del Río on the Gulf coast south of Veracruz City and south almost to the Isthmus of Tehuantepec (Lowery and Dalquest, 1951).

At Córdoba and Fortín, and in the Barranca Metlac a few kilometers north of Fortín, the Brown Jay is fairly common and widely distributed ecologically, although it is more often found in stands of forest bordering coffee groves than in other vegetation types (Plate 17). Of 36 birds seen or collected between July 27 and 29, 1957, all were the brown morph. The same region was visited for a short time in 1952 and 1954, and my notes show only records of the brown morph. Likewise, Lowery and Dalquest (1951: 618) did not encounter the white-tipped type here. Possibly it is occasionally found on the floor of the Barranca Metlac near Fortín, as residents of Rincón Brujo, a village in the Barranca reached by a side road leaving the Córdoba-Orizaba highway at Kilometer 326, were familiar with it and claimed to have seen it there.

It may be noted here that near Coatepec, approximately 40 miles north of Córdoba, at an elevation of 4680 feet, only the brown morph was recorded during a short visit in 1952 and from June 7 to 9, 1957. Vegetation at Coatepec is similar to that at Fortín and Córdoba.

Near Omealca, a small village near the Río Blanco, 6 miles southwest of San Juan de la Punta, at an elevation of 1370 feet, jays were common in riparian situations, citrus fruit orchards, banana groves, and other vegetation types. Climatic

(Above) Humid evergreen forest in Barranca Metlac, near Fortín de las Flores, Veracruz. Population at this locality is monomorphic brown. *(Below)* Coyol woodland 12 miles south of Boca del Río, Veracruz.



(Above) Habitat of *Psilorhinus* at Lake Catemaco, Veracruz. Approximately equal numbers of the two morphs occur in this region. *(Below)* Deciduous vegetation inhabited by *Psilorhinus* near Hueyapan, Veracruz.

data are not available for Omealca; but to judge from the growth forms of the dominant vegetation types, this is a region having a climate intermediate between those of the arid coastal plain to the east and the humid coffee zone to the west and north at higher elevations. Zonally the region is Upper Tropical. Of 17 jays seen here on June 16, 2 (11.8 per cent) were the white-tipped type.

On the coastal plain between San Juan de la Punta and the Gulf at Boca del Río, jays were encountered infrequently, and then usually in wooded arroyos or along the Río Atoyac. Woody vegetation over much of the coastal plain consists of shrubs and short trees which provide habitat not well-suited to these large jays. Annual rainfall is less than 1500 millimeters in many areas and is markedly seasonal. At Veracruz City, on the coast, annual rainfall is 1623 millimeters, and 86 per cent of it falls between June and October. However, along the rivers and streams, narrow stands of mangos, figs, guanacastes, and other large trees provide ideal habitat. In riparian vegetation in the vicinity of Boca del Río, the frequency of the white-tipped morph was 19.8 per cent; and 12 miles south of Boca del Río, in stands of coyols (Plate 17), a decidedly more xeric habitat type, the frequency was 40.6 per cent. The latter figure is based on a relatively small sample of birds and requires confirmation. Irby Davis (in conversation) reported a frequency of about 25 per cent white-tipped type in the La Piedra region, approximately 16 miles south of Boca del Río. The vegetation, as described by Davis (1952), is subhumid tropical grassland and wood mixture.

Catemaco region.—Headquarters were established at Playa Azul on the shore of Lake Catemaco, and studies were made at several points around the lake between elevations of 1000 and 1500 feet. Goldman (1951: 269) described this region as follows: "Cloud formations from over the Gulf discharge most of their moisture on the Sierra de San Martín, and the vicinity of Catemaco behind [west of] this mountain barrier is near the borderline between the Arid [Lower] and Humid [Upper] Tropical areas. The low hills, plains, and valleys about the western side of the lake are rather dry, being covered with small and sparse arboreal vegetation, and some open, grassy llanos are encountered. Elsewhere the heavy Humid Tropical forest prevails, descending to the water's edge along the eastern shore of the lake. Mahogany and Spanish cedar are among the forest trees."

Rainfall at San Andrés Tuxtla, about 5 miles east of Catemaco, is 2113 millimeters, and there is a dry season extending from January to May (Contreras Arias, 1942).

Brown Jays were found in greater numbers at Catemaco than at any other locality visited. They were abundant in fence rows, wooded arroyos, hillside woodland and forest bordering fields, and banana and citrus fruit trees (Plate 18). In smaller numbers they occurred also in coffee groves and disturbed stands of broad-leafed evergreen forest on the eastern side of the lake. Apparently the great diversity of vegetation types in this region favors high population densities, but there were no differences between the morphs as regards habitat occurrence.

A total of 149 jays was recorded, of which 48.3 per cent were the white-tipped morph.

Between Angel R. Cabada and Santiago Tuxtla, 5 to 10 miles west-northwest of Catemaco, 8 brown and 9 white-tipped birds were counted on July 26; the percentage white-tipped is 52.9. These localities are at slightly lower elevations than Catemaco, but the vegetation types are similar.

Hueyapan region, Veracruz.—Collections and counts were made at Hueyapan, 20-25 miles south and inland from Lake Catemaco, on July 7 and 8. This area

lies within the rain shadow of the Tuxtla Mountains, in the Arid Lower Tropical Zone at an elevation of 300 feet. Jays were only moderately common here, frequenting deciduous woodland having a dense understory of thorny shrubs (Plate 18), a distinctly more xeric type of vegetation than those occupied by jays at Catemaco. Only 14 jays were counted, 71.4 per cent of which represented the white-tipped morph. These data suggest a higher frequency of this morph at Hueyapan than at Catemaco, but confirmation by a larger count is desirable.

Minatitlán and Jáltipan-Cosaleacaque regions, Isthmus of Tehuantepec.—On July 1, headquarters were established at Minatitlán and studies were made in this region through July 5. Censuses were made at a point 2 miles northeast of Minatitlán and at Jáltipan de Morelos and Cosaleacaque, villages 15 and 10 miles east, respectively, of Minatitlán. The climate of this general area is more or less intermediate between those of the Arid and Humid Lower Tropical life-zones. At Minatitlán rainfall is high (3085 millimeters) and there is no well-defined dry season; but, apparently because of edaphic factors, the dominant vegetation types are grassland and palm savannah. There are also numerous marshes and boggy areas supporting stands of tall mesic vegetation. Jays were common in these stands but were everywhere less numerous than at Catemaco. At Cosaleacaque and Jáltipan, jays were found in stands of mesic vegetation along the highway and in patches of tall forest between agricultural fields.

The white-tipped morph was relatively less common at Cosaleacaque and Jáltipan than at Minatitlán (see Table 3), but the census data are not entirely reliable because of the small size of the samples. Combining census data from the three localities, the percentage of the white-tipped type is 26.3, based on a total of 57 birds.

Nanchital-Agua Dulce region, Veracruz.—On July 2, I drove from Coatzacoalcos to Nanchital and thence east to Agua Dulce (Tonalá) on the Río Tonalá about 20 miles east of Coatzacoalcos. This region apparently is more humid than Minatitlán, and the abundant rainfall supports a tall evergreen forest having a notable development of epiphytes. The original vegetation is relatively undisturbed except for scattered small villages and roads which cut through the forest to provide access to oil wells. Jays were sparsely distributed here and only 8 were identified; all represented the brown morph. L. I. Davis and Morony (1953) reported the brown but not the white-tipped morph from a census plot in humid tropical grassland and woods mixture 17 miles east (by road) of Nanchital, and L. I. Davis (1955) noted the "complete absence of jays of any kind" in "virgin" lowland tropical forest 10 miles south (by road) of San José del Carmen, or about 30 miles south of Agua Dulce. Further investigation in this area is indicated; possibly the population is monomorphic brown.

Matías Romero region, Isthmus of Tehuantepec.—From July 10 to 12, jays were studied along the highway across the Isthmus of Tehuantepec. In humid and, locally, mesic evergreen tropical forest and woodland along the highway from 4.1 to 70 miles north of Matías Romero, 48 Brown Jays were collected or observed, 41.7 per cent of which were the white-tipped morph. Forests in this region are relatively undisturbed, and, as a result, jays are not so abundant as in the Catemaco region or other more heavily settled areas.

Lowery and Dalquest (1951: 618) report finding only the white-tipped type "along the Río Coatzacoalcos, in southern Veracruz." However, both morphs occur in this region, and the brown is at least as common as the white-tipped morph.

F. W. Loetscher, Jr., reports (in letter) that the brown morph was "overwhelmingly in the majority around Jesús Carranza" in August, 1937, and March, 1939; and Amadon and Eckelberry (1955: 76) found the brown in greater numbers than the white-tipped type along the Río Jaltepec, a tributary of the Río Coatzacoalcas.

The point of contact on the Isthmus between *Psilorhinus* and *Calocitta* was located by driving along the highway and stopping to investigate wooded arroyos. At a point 4.8 miles north of Matías Romero, a group of *Psilorhinus* consisting of 6 white-tipped and 3 brown morphs was present in a stand of forest composed of a mixture of humid and xeric elements. A small group of brown morphs was noted in a similar situation 4.1 miles north of Matías Romero. At a point 3 miles north of Matías Romero, a low ridge, the Continental Divide, was crossed. In the next arroyo, 2.3 miles north of Matías Romero, a family group of *Calocitta* was found in vegetation only slightly more xeric than that in which *Psilorhinus* occurred 1.8 miles to the north. Other groups of *Calocitta* were seen in typical Pacific coastal plain vegetation 15 miles south of Matías Romero.

The Green Jay *(Cyanocorax yncas)* was present with *Calocitta* in the arroyo 2.3 miles north of Matías Romero and is fairly common throughout the humid part of the Isthmus to the north, where it is sympatric with *Psilorhinus*. The Green Jay frequents understory vegetation, whereas the larger jays are more often found in the upper vegetational strata.

Teapa, Tabasco.—Teapa lies at an elevation of about 225 feet at the base of the mountains which form the highland plateau of central Chiapas (Fig. 2). Annual rainfall is 3967 millimeters and is rather well distributed throughout the year; April is the driest month, with 144 millimeters. Rain fell almost continuously during my stay in July.

On the hillsides just south of town, heavy rain forest has been partly cleared for coffee and pitaya, providing excellent habitat conditions for jays. Residents of Teapa reported that Brown Jays were also abundant in coffee fincas at higher elevations. On the coastal plain from one to three miles north of town, where rainfall is less abundant and the land is more extensively cultivated, jays were common in pastures, along streams, and in narrow stands of forest between milpas. The general aspect of the vegetation is closely similar to that at Omealca, Veracruz.

Morph-frequency was similar in the hills and on the coastal plain; 27.1 per cent of 48 birds recorded within a three-mile-radius of Teapa represented the white-tipped morph.

Nothing is known concerning morph-frequency on the extensive coastal plain of Tabasco north of Teapa. A few Brown Jays were heard 5 miles south of Villa Hermosa, on July 14, but the morph-type was not determined. *Cissiolopha yucatanica* was present at Villa Hermosa and Teapa, where it occupied the same types of habitat situations frequented by *Psilorhinus*. At both localities it is apparently less common than *Psilorhinus*.

Palenque, Chiapas.—Palenque lies at an elevation of 750 feet at the dividing line between forested foothills to the south and grassy plains to the north. Annual rainfall is approximately 3200 millimeters and there is no marked dry season. "The dense, humid, tropical forest of the mountain slopes and foothills gives place to a smaller growth on the plains, and large areas between Palenque and Monte Cristo are open savanna interrupted by, or alternating with, irregular patches and belts of timber" (Goldman, 1951: 108). Ecology of the rain forest in the vicinity of the archaeological ruins of Palenque was studied by Goodnight and Goodnight (1956), and Tashian (1952) reported on a small collection of birds from Palenque.

I found *Psilorhinus* scarce along rain forest edges at the ruins but not uncommon in forest remnants, cafetales, riparian growth, and meadows near town from July 18 to 22. The white-tipped morph predominated (Table 3), but 23.9 per cent of birds recorded were the brown morph.

There are records of white-tipped morphs from the mountains of central and northern Chiapas near San Fernando, Ocosingo, and El Real (Fig. 2). Rainfall is considerably less at these localities than at either Teapa or Palenque; at Ocosingo annual precipitation is 1666 millimeters (Contreras Arias, 1942).

GEOGRAPHIC VARIATION IN OTHER CHARACTERS

Morph-frequency is one of several geographically variable characters in *Psilorhinus*. There are other more or less independent patterns of geographic variation in color and in size.

Size.—Individual and geographic variation in length of wing, bill, and tarsus in adult males is shown in Figure 3. Wing length is uniform in México north of Tabasco and Chiapas, but there is some suggestion of slightly longer average wing length in polymorphic populations of central and southern Veracruz. In material from Central America (Guatemala, Honduras, Nicaragua, and Costa Rica), the wing is somewhat shorter, on the average, and birds from the northern Yucatán Peninsula have markedly shorter wings. A similar pattern of geographic variation is apparent in tail length.

There is close similarity in geographic patterns of variation in bill length and body weight. Birds from Veracruz, including the Sierra Madre and the lowlands, are significantly heavier and have longer bills than those from northeastern México north of Veracruz. Central American populations average lighter in weight and are shorter-billed. In the Yucatán population minimal size is manifest.

In tarsal length the polymorphic populations of Veracruz average slightly larger than those of northeastern México and the Sierra Madre of Veracruz. Again minimal size is seen in Yucatán birds. In all characters of size, the polymorphic population of Tabasco and Chiapas falls in a position intermediate between the adjacent large-sized, polymorphic population of Veracruz and the moderate-sized, monomorphic Guatemalan population.

Color.—An objective analysis of geographic variation in color has been possible through use of a Photovolt Meter registering percentage reflected light (see Blair, 1949, for details of the technique). Because the equipment is not designed to measure unfiltered (white) light, a red filter was used for all readings. The amount of light reflected from a porcelain block was taken as a standard of 100 per cent reflectance, and a piece of black velour paper served as a standard of 0 per cent reflectance. Small numbers are obtained for dark shades, large numbers for light shades. Results obtained with the Photovolt Meter (Fig. 4) agree closely with those of subjective evaluation of individual and geographic variation in darkness and lightness (value) of the areas of the specimens studied.

Individual and geographic variation in color of the abdomen and breast in adults was studied (Fig. 4). There is no significant sexual variation in color. The wide range of variation seen in any one sample results in some part from differences in degree of seasonal fading, but the data provide at least a good indication of geographic trends in color.

In Tamaulipas and Nuevo León, the abdomen is markedly lighter than in other

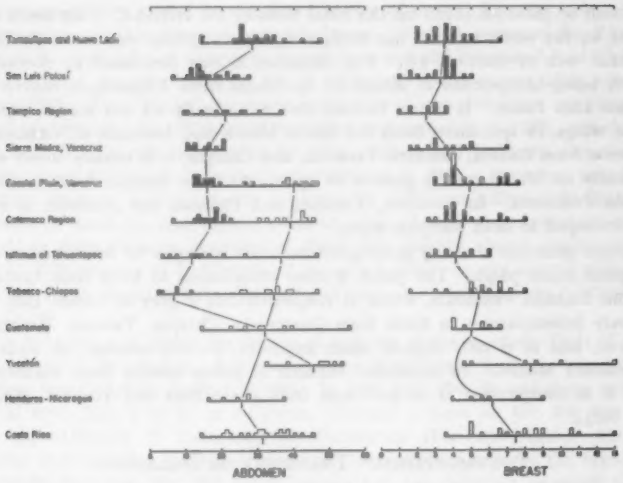


FIGURE 4. Individual and geographic variation in shade of abdomen and breast. Scale indicates percentage reflectance of red light. Black squares represent brown morph; open squares, white-tipped morph.

monomorphic brown populations or in brown morphs from Veracruz, Oaxaca, Tabasco, and Chiapas. The color is similar to that of monomorphic white-tipped birds from Central America. The "influence" of this light population is seen to some extent in the sample from the Tampico region. Brown morphs from San Luis Potosí south to the Catemaco region have dark abdomens; and there is a clinal increase in darkness south from the Catemaco region to Tabasco and Chiapas. In some specimens from Tabasco and Chiapas, the abdomen is nearly as dark as the breast and back.

In the white-tipped morph, abdominal color varies clinally from 45 on the coastal plain of Veracruz to about 31 in Honduras and Nicaragua and 30 in Costa Rica. It will be noted that in samples of the polymorphic populations there is no overlap in color between the morphs.

Breast color changes clinally from dark in northeastern México to light in Central America and the Yucatán Peninsula. The polymorphic populations apparently are slightly lighter than monomorphic populations to the north, and there is no significant difference in breast color between the morphs in any one population.

The fact that breast color is paler in birds from Tabasco and Chiapas than in those from the Isthmus of Tehuantepec and Lake Catemaco requires explanation. All but one specimen from Tabasco and Chiapas were collected in late July and are, on the average, more worn and faded than are specimens from the other regions. In all probability fresh adult specimens from Tabasco and Chiapas would average even darker than those from Veracruz. In any event, this is the case in juvenal specimens collected in June and July, 1957.

John Davis (1951) has called attention to geographic variation in intensity of

the bluish or glaucous sheen on the outer webs of the rectrices. This sheen is also present on the outer webs of the remiges and their greater upper coverts and on the inner web of rectrices 1-1. The character is best developed in northeastern México, being conspicuous in almost all specimens from Tamaulipas, Nuevo León, and San Luis Potosí. It is less intense, and occasionally all but absent, especially on the wings, in specimens from the Sierra Madre and lowlands of Veracruz. In specimens from Oaxaca, southern Veracruz, and Chiapas, it is usually barely visible. Practically no bluish cast is present in specimens from Central America and the Yucatán Peninsula. In Veracruz, Tabasco, and Chiapas, the character is equally well developed in both morphic types.

Another character showing geographic variation is degree of development of the triangular malar patch. The patch is most conspicuous in birds from Costa Rica and the Yucatán Peninsula, where it frequently has a gray or bluish cast. It is relatively inconspicuous in birds from Guatemala, Chiapas, Tabasco, Oaxaca, and Veracruz, and it is only slightly more apparent, on the average, in birds from northeastern México. In occasional variants of either morph from Veracruz, the patch is as conspicuous as in specimens from Costa Rica and Yucatán (Ridgway, 1904: 302).

POLYMORPHISM: TRANSIENT OR BALANCED?

As pointed out by Ford (1940, 1945), genetically controlled polymorphism includes two different conditions: (1) *transient polymorphism,* in which an advantageous gene is in the process of spreading through a population, and (2) *balanced polymorphism,* in which an advantageous gene is maintained at some fixed level of frequency in a given population by a balance of selective agencies. The former is a temporary condition maintained only during the time that a gene is in the process of replacing its allelomorph, whereas balanced polymorphism is characterized by stability of morph-ratios in time. The simplest stable equilibrium occurs when a heterozygote has a selective advantage over either homozygote. Various examples of these phenomena are cited by Ford (1945).

If polymorphism in *Psilorhinus* is transient, we may expect to find evidence of change in morph-frequencies in already polymorphic populations and/or extension of range of one or both morphs. Conclusive evidence is not presently available and will not be for some time to come, but the few data bearing on the problem suggest that polymorphism in *Psilorhinus* is balanced.

In 1939, Wetmore (1943: 297) found the two morphs "in about equal number" at Tres Zapotes, Veracruz, and, as noted elsewhere, in 1957 the percentage of the white-tipped morph in the adjacent Catemaco region was 48.3. The two areas differ climatically, so perhaps comparisons ought not to be made; but at the present time this is the nearest we can come to comparing frequencies in different years for any locality within the range of the polymorphic populations.

It is possible that the white-tipped morph formerly occurred in low frequency

in northeastern México and in the Sierra Madre of central Veracruz, where today populations apparently are monomorphic brown. This is suggested by Rüppell's record of the white-tipped morph in Tamaulipas and old records of it at "Jalapa," "Coatepec," and "Mirador" (see pp. 392–3). Rüppell's specimen was taken sometime prior to 1837. The "Jalapa" specimen was collected over 106 years ago (reported in 1851 by Cabanis); the "Coatepec" specimen was collected in 1888; and the first "Mirador" specimen was taken prior to 1887. Nelson and Goldman also collected a white-tipped morph at "Mirador" on February 3, 1894. However, considering the looser practices in labeling and reporting of specimens collected in México in the 1800's, it would be most unwise to assume that changes in gene-frequency have occurred in these areas on the basis of these early records. Many species of birds which in Veracruz are in fact restricted to xeric habitats on the coastal plain have been erroneously reported from "Jalapa" and "Mirador" (see remarks by Chapman, 1898: 16–18).

Little is known concerning the degree of stability of the southern limit of distribution of the brown morph. A specimen from Montecristo, Tabasco, was collected by Nelson and Goldman on May 3, 1900. In 1939, Eizi Matuda and three assistants collected from May 9 to 20 at Balancán, Tabasco, a town on the Río San Juan Pedro approximately 15 miles east of Montecristo (Brodkorb, 1943). Matuda's collection included four specimens of the white-tipped but none of the brown. It is probable, therefore, that the brown morph had not extended its range beyond Montecristo in the interval from 1900 to 1939. Further work is badly needed here, as elsewhere in México, before the problem of transient or balanced polymorphism is finally resolved.

DISCUSSION

Study of patterns of ratio-clines may be expected to provide clues to environmental selective agencies maintaining balanced polymorphism (Huxley, 1955). In *Psilorhinus* it is obvious that the subject is fairly complex and will require further investigation, but sufficient data are available to justify a tentative interpretation. Before proceeding, it may be well to point out that the obvious color differences distinguishing the morphs probably do not have great significance in themselves. The particular character or characters being selected may well be of a physiological nature, perhaps having to do with temperature or humidity tolerance. Most known polymorphisms involve apparent non-adaptive correlates of physiological or fitness characters having selective value (Huxley, 1955: 311). On the other hand, the brown morph is relatively less conspicuous against a background of dark, evergreen vegetation than is the white-tipped morph, and the light colors of the latter may be more advantageous in xeric habitats. Therefore, the possibility that color and pattern types themselves have differential adaptive values, at least in some areas, cannot be completely ruled out.

If we consider only the polymorphic population occurring from central Veracruz south and east to Teapa, Tabasco, it appears that

there is a general relation between morph-ratios and climate. Temperature varies little over much of the range of the polymorphic population, but there are major variations in rainfall and atmospheric humidity. Relatively large percentages of the white-tipped morph are found in populations in arid or mesic environments, and a predominance of the brown morph is seen in the more humid areas.

In the field this relationship was first evident in the transect from Boca del Río up the eastern slope of the Sierra Madre of central Veracruz through Omealca to the Fortín-Córdoba region. In this situation it is unlikely that altitude itself has any direct effect, but precisely what factor or combination of factors acts as a selective agency is unknown. The apparent higher percentage of the white-tipped morph in xeric coyol woodland south of Boca del Río, as compared to that in the more mesic riparian vegetation along the Río Atoyac, is of interest in this connection. In this region riparian stands of trees provide avenues of dispersal between the Sierra Madre and the mesic lowlands near the coast, whereas the coyol woodland is relatively more isolated from the brown populations in the mountains. This introduces an important aspect of the problem being considered. The relative frequency of the two morphs in any one limited area will depend, among other things, on the interaction and balance of local selective forces and gene-exchange with populations in adjacent areas in which selective forces and, hence, the morphic composition of the population, may differ considerably. These facts must be considered in interpreting the significance of morph-frequencies at different localities.

At Lake Catemaco, mesic conditions exist, and, to judge from the abundance of jays, provide optimum habitat for the species. The two morphs are about equally common. At Hueyapan, in a decidedly more xeric environment, the white-tipped morph seemingly predominates. Considering general climatic conditions at Minatitlán, a percentage of 38.8 for the white-tipped morph is not surprising, but the Jáltipan-Cosaleacaque ratio is unexpectedly low in white-tipped morphs. A ratio of 50:50 would seem more in line with expectations based on observations at Catemaco and elsewhere to the north. The percentage of white-tipped morphs (41.7) in the Matías Romero region is not far out of line, although a rather lower frequency might be expected considering the relatively humid climate of that region.

At Teapa, conditions are even more humid than at Fortín de las Flores and Catemaco, and, on this basis, following the hypothesis suggested, a monomorphic brown population might be expected. However, the town lies only a few miles inland from mesic savannah on the coastal plain, so that influx of genes may be expected (see, also, beyond).

The high frequency (76.1 per cent) of the white-tipped morph recorded at Palenque is way out of line and totally unexpected, but this does not necessarily negate the hypothesis. Even neglecting morph-frequencies, the Palenque population obviously is genetically different from those in Veracruz; this is evidenced in body size and in color of upper parts and breast. Morphologically, the population approaches populations of medium-sized birds of Guatemala and

Central America, which are monomorphic white-tipped. It is possible that the brown gene or super-gene (Ford, 1955) has distinctly lower survival value on the genetic background or "genetic environment" (Mayr, 1954) of the Palenque population than on backgrounds of other polymorphic populations. Moreover, it is unlikely that environmental selective forces are the same at Palenque as at Fortín, several hundred miles to the north. This same explanation would also help account for the high percentage of white-tipped morphs in the morphologically similar population at Teapa, Tabasco.

In Guatemala and other parts of Central America, Brown Jays occur in regions fully as humid as those in Veracruz, and also in mesic and xeric environments, but the populations are uniformly white-tipped. We may presume that either (1) the brown gene or super-gene is disadvantageous in these regions on the genetic background of these populations, or (2) the brown gene has not yet reached these populations. The former seems more probable. There are many species in which dimorph-clines connect monomorphic populations (Ford, 1945: 82). A polymorphic situation may be advantageous in one part of the range of a species but not in other parts.

North of central Veracruz, Brown Jays inhabit humid areas, as at Xilitla, San Luis Potosí, and xeric environments, as in Tamaulipas and Nuevo León, yet these populations are uniformly monomorphic brown. Again the question arises as to why the other morph is absent, and the suggestions made in reference to the Central American situation may well apply, but in reverse. It is possibly significant that in Tamaulipas and Nuevo León, where jays occur in particularly xeric habitats, birds have light abdomens; they approach in this character the white-tipped morph of Veracruz, although the tail is not white-tipped. Perhaps similar physiological adaptations to arid habitats have been made in both areas, but in the former case without development of the genetic mechanism responsible for visible polymorphism.

Just north of the northern limit of the white-tipped morph in Veracruz, the Sierra closely approaches the Gulf coast and the climate is humid on the coastal plain (Fig. 2). If in central Veracruz genotypes which have the white-tipped gene are disadvantageous under humid conditions, this humid zone would serve as a barrier, or at least a "bottle-neck," to dispersal of genes into more northern populations. The effect would be to lessen the rate of flow of white-tipped genes into these populations, thereby decreasing the probability of their reaching areas in which they might not be subject to elimination by counter-selection, if indeed such areas exist. There is, it should be

noted, no comparable "bottle-neck" to gene dispersal at the other end of the polymorph area.

Corvid evolution and relationships in México and Central America are not by any means well understood, but it seems quite certain that *Psilorhinus* is closely related to *Cyanocorax* (Amadon, 1944). Because white tips to the tail and pale under parts are basic pattern components of a number of jays of the genus *Cyanocorax*, it is highly probable that the white-tipped morph of *Psilorhinus* is morphologically "primitive" and the brown represents a secondary modification of the white-tipped pattern. Moreover, another close relative of the Brown Jay is *Calocitta*, with which it has hybridized in Chiapas (Pitelka, *et al.*, 1956). This jay is blue dorsally and has white posterior under parts and tips to the tail. Since *Calocitta* is a xeric-adapted species, there is a good possibility that the ancestor of the Brown Jay, perhaps a *Calocitta*-like form, was adapted to xeric or mesic rather than humid environments, and that the adaptation of the Brown Jay to humid habitat types was a secondary development.

It is possible that the present pattern of polymorphism was originally established by secondary contact and introgressive hybridization between a monomorphic brown population which evolved in humid environments in northeastern México and originally xeric- or mesic-adapted white-tipped birds occupying Central America or southeastern México. Later, perhaps, the brown population moved into xeric environments in Tamaulipas and other areas, where in ventral coloration it approaches the white-tipped type. Similarly, the white-tipped Central American populations could have managed to inhabit humid vegetation types without making the particular genetic adjustments accompanied by brown morphism. All of this is highly speculative. In any event, however, the fact that polymorphism is shown over an extensive area and that there is a complex ratio-cline connecting "pure" monomorphic populations on either side of this area tends to rule out the possibility that polymorphism is maintained merely by gene-flow from centers in which one or the other of the types is at an advantage (Ford, 1945: 80, 82). Polymorphism in *Psilorhinus* is apparently balanced, but as yet no information is available concerning the intrinsic balance mechanism.

NOMENCLATURE AND SUBSPECIES

The correct name of the Brown Jay is *Psilorhinus morio* (Wagler); the type locality, formerly believed to be Jalapa (see J. Davis, 1951), apparently is Alvarado, Veracruz (Stresemann, 1954: 89).

In my opinion, formal recognition of subspecies in *P. morio* is of

questionable value. However, if subspecies are to be recognized, I suggest the following arrangement, which is based mainly on two geographically variable characters, size and presence or absence of polymorphism.

Psilorhinus morio morio (Wagler)

Pica Morio Wagler, 1829, Isis von Oken, col. 751 (Mexico = Alvarado, Veracruz)
Psilorhinus morio palliatus van Rossem, 1934, Bull. Mus. Comp. Zool., 77: 415 (Ciudad Victoria, Tamaulipas)

Characters.—Large size; monomorphic brown.

Range.—Northeastern México from Tamaulipas and Nuevo León south to central Veracruz (latitude 19°25′), and in Sierra Madre of Veracruz above 2000 feet elevation south at least to Córdoba.

Psilorhinus morio fuliginosus (Lesson)

Pica fuliginosa Lesson, 1830, Traite d'Ornith., livr. 5: 333 ("Mexique"; type lost)
Psilorhinus mexicanus Rüppell, 1837, Mus. Senckenb., 2, heft. 2: 189 ("Tamalipas" = Tamaulipas = central or southern Veracruz (?); based on white-tipped morph)

Characters.—Large size; polymorphic.

Range.—Southeastern México from coastal plain of central Veracruz south and east to eastern Tabasco (Montecristo) and northern Chiapas (Palenque).

Psilorhinus morio cyanogenys Sharpe

Psilorhinus cyanogenys Sharpe, 1877, Cat. Birds Brit. Mus., 3: 140 ("Pearl-Bay Lagoon, Mosquito" = Pearl Cay Lagoon, Nicaragua)
Psilorhinus mexicanus captus Kennard and Peters, 1927, Proc. New Engl. Zool. Cl., 10:2 (Chiriquicito, northwestern Panamá)

Characters.—Medium size; monomorphic white-tipped.

Range.—Extreme eastern Tabasco (Balancán) south and east through Central America (except El Salvador) to the Almirante region, Panamá.

Remarks.—*P. m. captus* reportedly differs from *P. m. cyanogenys* in minor details of ventral coloration and in having smaller white tail-patches. These characters, particularly the latter, should be checked in series of specimens segregated as to age. I have seen only a single specimen, a juvenile, from the Almirante region; it is closely similar to specimens from Costa Rica.

A specimen from Palma Real, Ocosingo, Chiapas, is similar in all respects to birds from Guatemala. If the population of the highlands of central Chiapas proves to be monomorphic white-tipped, this bird and others from the same region may arbitrarily be referred to *P. m. cyanogenys.*

Psilorhinus morio vociferus (Cabot)

Corvus vociferus Cabot, 1843, Proc. Boston Soc. Nat. Hist., 1: 155 (Yucatan)

Characters.—Like *P. m. cyanogenys* in being monomorphic white-tipped, but smaller and paler, with posterior under parts whiter and lacking gray on thighs.

Range.—Northern Yucatán Peninsula in Yucatán, Quintana Roo, and Campeche.

Remarks.—Paynter (1955: 213), who examined a considerable number of specimens of *P. m. vociferus,* notes that it may be distinguished from *cyanogenys* "most easily, by the total lack of gray on the thighs." *P. m. vociferus* intergrades with

P. m. cyanogenys in southern Campeche and along the Río Hondo between Quintana Roo and British Honduras (Paynter, *op. cit.*, 213–214). Paynter was correct in supposing that Traylor's (1941) specimen from Matamoros, Campeche, is not typical of either race. The bird, a first-year female, is intermediate in size and color between Guatemalan specimens *(cyanogenys)* and those from the northern Yucatán Peninsula. Paynter reported an intergrade from 20 miles north of Escárcega. Traylor's specimen (adult female) from Pacaytún, about 50 miles southwest of Matamoros, is "typical" *P. m. cyanogenys*.

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SUMMARY

Relationships of two nominal species of jays, the Brown Jay *(Psilorhinus morio)* and the White-tipped Brown Jay *(P. mexicanus)*, in eastern México were studied. Evidence is marshalled to show that the two are color phases (morphs) of a single species.

North of latitude 19°25′ in central Veracruz all jays are the brown morph; from central Veracruz south to eastern Tabasco both morphs are found together in varying frequency-ratios; and populations in Central America and the Yucatán Peninsula are monomorphic white-tipped. Within the range of the polymorphic populations both types are identical in size, are found in the same family group, are constantly associated, and show no differences in habitat occurrence or behavior. Available evidence from composition of family groups suggests that brown is genetically dominant over the white-tipped pattern.

Study of patterns of ratio-clines, based on censuses at 13 localities in Veracruz, Oaxaca, Chiapas, and Tabasco, shows a general relation between morph-ratios and climate. Within the polymorphic range, relatively high frequencies of the white-tipped morph are found in arid and mesic regions, and a predominance of the brown morph is seen in more humid areas. Elsewhere within the species' range, however, monomorphic populations of either type occupy both humid and xeric regions.

The obvious color and pattern differences between the morphs are believed to be non- or weakly-adaptive correlates of underlying physiological characters, such as temperature or humidity tolerance, having differential selective values. The extent of the area over which polymorphism exists and the complexity of ratio-clines within this area indicate that polymorphism is not maintained merely by gene-flow from adjacent monomorphic populations. Polymorphism in *Psilorhinus* may have been originally established by secondary contact and hybridization between monomorphic populations, but, in any event, it is now apparently balanced.

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APPENDIX

List of Specimens Examined

Sample 1. Tamualipas and Nuevo León; 50 specimens; all brown morph.

Tamaulipas: Camargo, 2 (♀ adult and ♀ first-year, collected on January 16, 1902, by Nelson and Goldman); Villagrán, 3; 5 mi. S Villagrán, 1; Río Pilón, 2; Ciudad Victoria, 5; Alicia, 60 mi. S Victoria, 1; Río de Corona, 1000 ft., 20 km. NNW Ciudad Victoria, 1; Santa Engracia, 6; 1 mi. N Magueyes, 1; Cañon de Galeana, 1; Río Sabinas, near Gómez Farías, 2; Cañon Guiaves (?), 2500 ft., 1; 10 mi. S Linares, 1; 14 km. S Mante, 1; Arroyo los Miradores, 1 km. W Km. 619, 22 mi. N Limón, 1. *Nuevo León:* Monterrey, 6; Hacienda de las Escobas, 1; Cerro de la Silla, 3; Montemorelos, 2; San Diego, Río San Juan, 1; Boquilla, 6; China, 1; no further locality, 1.

Sample 2. San Luis Potosí; 29 specimens; all brown morph.

San Luis Potosí: El Naciemento del Coy, 1; Ebano, 2; Cerco de Ebano, 2.5 mi. SSE Ajinche, 1; Hacienda Limón, 10 mi. W Ebano, 1; 4 mi. beyond Ajinche on road to Oviedo, Ebano region, 2; 19 km. W Ebano, 1; Paso de Botella, 1500 ft., 5 mi. SW Sta. María Acapulco, 2; Valles, 3; Tamuín region, 1; 1 mi. S. Tamuín Station, 1; Xilitla, 2000 ft., 3; 1 mi. W Xilitla, 2400 ft., 1; 4 mi. E Xilitla, 1000 ft., 1; 3 mi. W Naranjo, 2; E of Tamazunchale, 1; El Sol, 1 mi. N Tamazunchale, 1; 4 mi. E Tamazunchale, 1; El Banito, 1; Puerto de Diablo, 6600 ft., Cerro Coneja reg., 1; Puente de Dios, Río Santa María 2.

Sample 3. Tampico region, southern Tamaulipas and northern Veracruz; 18 specimens; all brown morph.

Tamaulipas: Tampico, 10; Cervantes, 2. *Veracruz:* Tamesí River near Rayón, 2; 30 mi. S Tampico, 2; 40 mi. S Tampico, 1; 30 mi. N Tuxpan, 1.

Sample 4. Sierra Madre, central Veracruz; 22 specimens; all brown morph.

Veracruz: 3 mi. S. Jalapa, 1; Coatepec, 4500 ft., 2; Mirador, 1; Potrero Viejo, 10 mi. E Córdoba, 1750 ft., 1; Ojochico, 7; Fortín de las Flores, 6; 2 mi. N Fortín, 3200 ft., 1; Barranca Metlac, 1; Río Atoyac, 8 km. NW Potrero, 2.

Sample 5. Coastal plain, central Veracruz; 37 specimens; both morphs.

BROWN MORPH; 22 SPECIMENS

Veracruz: Palma Sola, 1000-1200 ft., SE Cuitláhuac, 3; Puente Nacional, 3; 9 mi. SSW[=S] Boca del Río, 7; 14 mi. SSW Boca del Río, 3; 12 mi. S Boca del Rio, 6.

WHITE-TIPPED MORPH; 15 SPECIMENS

Veracruz: Palma Sola, 1200-1250 ft., SE Cuitláhuac, 3; Arroyo de Piedra, 1.7 mi. NE La Capilla, 1; "Mirador," 1; 3 km. W Boca del Río, 1; 14 mi. SSW Boca del Río, 3; 9 mi. SSW[=S] Boca del Río, 1; 12 mi. S Boca del Río, 3; 20 mi. S Veracruz City, 1; Río Blanco, 20 km. WNW Piedras Negras, 1.

Sample 6. Catemaco region, Veracruz; 48 specimens; both morphs.

BROWN MORPH; 32 SPECIMENS

Veracruz: Catemaco, 5; Lake Catemaco at Playa Azul, 11; Lake Catemaco at Coyame, 9; 10 mi. SW Catemaco, 1; Angel R. Cabada, 3; Hueyapan, 3.

WHITE-TIPPED MORPH; 16 SPECIMENS

Veracruz: Catemaco, 5; Lake Catemaco at Playa Azul, 6; Lake Catemaco at Coyame, 3; 10 mi. SW Catemaco, 4; Santiago Tuxtla, 1; Angel R. Cabada, 1; Hueyapan 1.

Sample 7. Isthmus of Tehuantepec, southern Veracruz and Oaxaca; 21 specimens; both morphs.

BROWN MORPH; 17 SPECIMENS

Veracruz: Achotal, 1; Jáltipan, 4; Cosaleacaque, 10 mi. W Minatitlán, 4; 2 mi. NE Minatitlán, 2; Pasa Nueva, 1. *Oaxaca:* 4 mi. N Matías Romero, 4; Guichicovi, 1.

WHITE-TIPPED MORPH; 4 SPECIMENS

Veracruz: Jáltipan, 1; 2 mi. NE Minatitlán, 2; Pasa Nueva, 1.

Sample 8. Tabasco and Ciapas; 28 specimens; both morphs.

BROWN MORPH; 10 SPECIMENS

Tabasco: Teapa, 7; Montecristo, 1. *Chiapas*: Palenque, 2.

WHITE-TIPPED MORPH; 18 SPECIMENS

Tabasco: Teapa, 1; Montecristo, 1. *Chiapas*: Palenque, 13; Palma Real, Ocosingo, 1; 5.4 mi. NW San Fernando, 2000 ft., 2.

Sample 9. Guatemala; 18 specimens; all white-tipped morph.

Guatemala: Los Amates, Izabel, 5; Bobos, Izabel, 1; Remate, Petén, 1; Macanché, Petén, 1; Chuntuqui, Petén, 1; Panzos, 1; Puebla, 1; Finca Chama, 1; Miles Rock, 1; Coban to Clusec, 2; no further locality, 3.

Sample 10. Yucatán, northern Campeche, and northern Quintana Roo; 14 specimens; all white-tipped morph.

Yucatán: Xocempich, 3; Chichén Itzá, 3; San Felipe, 1; no further locality, 2. *Campeche:* 15 mi. S Campeche, 2; Canasayab, 1; San Juan, 1. *Quintana Roo*: La Vega, 1.

Sample 11. Honduras and Nicaragua; 14 specimens; all white-tipped morph.

Honduras: Truxillo, 1; Chamelicón, 2; La Ceiba, 1; El Boquerón, Catamacas, 1; Alto Guaymaca, Tegucigalpa, 3000 ft., 1; Balfate, Prov. Colón, 1. *Nicaragua:* Segovia R., 4; Managua Río, 1; Matagalpa, 1; San Rafael del Norte, 4000 ft., 1.

Sample 12. Costa Rica; 39 specimens; all white-tipped morph.

Costa Rica: Copey, 1; "Sibahue," 1; San José, 4; Volcán de Irazú, 1; Talamanca, 2; Guayabo, 9; Bonilla, 1; Santa María de Dota, 3; Carillo, 1000 ft., 1; Aginares, slope Vol. Turrialba, 3800 ft., 1; San Isidro, Vol. Irazú, 1; Agua Caliente, 4500 ft., 1; Limón, 1; Juan Viñas, 1; Coliblanco, 1; Peralta, 1; La Lola, Madre de Dios, 3; Parás, 1045 m., 7 km. W San José, Prov. San José, 1; no further locality, 5.

Additional Specimens Examined

BROWN MORPH

Oaxaca: Tuxtepec, 3; Palo Blanco, 3 km. Oeste Tuxtepec, 1. "Tamaulipas," 1; "City of Mexico," 1; "Hacienda Santa Gratias," 1.

WHITE-TIPPED MORPH

Oaxaca: Tuxtepec, 2. *Chiapas*: 5.4 mi. NW San Fernando, 2000 ft., 2; "Mexico," 1. *Campeche*: Matamoros, 1; "Pacaitun"[=Pacaytún], 1. *Quintana Roo*: Coba, 1. *Panamá*: Boca[=Bocas] del Toro, Almirante, 1. There is a specimen in the British Museum (Natural History) from Playa Vicente, Veracruz (*fide* Pitelka, in letter).

Selected Additional Locality Records from the Literature

BROWN MORPH

Veracruz: Tres Zapotes (Wetmore, 1943: 296); Río Blanco, 20 km. W Piedras Negras, 400 ft. (Lowery and Dalquest, 1951: 617); Jalapa (Sclater, 1859: 365); Rinconada (Lantz, 1899: 222); 17 mi. E (by road) Nanchital (L. I. Davis and Morony, 1953). *Tabasco:* Río Macuspana (reported by Rovirosa in vol. 7 of Naturaleza, 1887: 367, *fide* Brodkorb, 1943: 71). *Oaxaca:* Soyaltepec (Miller, *et al.*, 1957: 130). *Puebla:* 30 mi. E Huauchinango (Miller, *et al.*, 1957: 130).

WHITE-TIPPED MORPH

Veracruz: Rinconada (Lantz, 1899: 222); 1 km. E Mecayucan, 200 ft., 20 mi. ESE Jesús Carranza, 400 ft. (Lowery and Dalquest, 1951: 617); Tres Zapotes (Wetmore, 1943: 297); along Río Jaltepec where highway crosses (Amadon and Eckelberry, 1955: 76). *Oaxaca:* Ridgway (1904) apparently was in error in listing Guichicovi as a locality for the white-tipped morph. The record is based on a specimen reported by Lawrence (1876: 25) as *P. morio*. Also, the locality is in Oaxaca, not Chiapas as indicated by Ridgway.

IN MEMORIAM: JOHN TODD ZIMMER

BY ROBERT CUSHMAN MURPHY AND DEAN AMADON

John Todd Zimmer, a Fellow of the American Ornithologists' Union, was born at Bridgeport, Ohio, on February 28, 1889, and died at White Plains, New York, shortly before his 68th birthday, on January 6, 1957. His youth and early career as a naturalist were chiefly associated with Nebraska. He graduated from the State University at Lincoln in 1910 and received the Master's degree in the following year. At the height of his career, in 1943, his *Alma Mater* conferred upon him the honorary degree of Doctor of Science.

Although his first scientific specialization was in entomology, he had an early interest in ornithology as well. During his college years he made an excellent collection of Nebraska birds. This always remained in his possession and was bequeathed to the University of Nebraska as a result of a wish expressed shortly before the end of his life.

After college, Zimmer spent two years as Field Entomologist with the Nebraska Experiment Station and concurrently served as collaborator with the United States Department of Agriculture. The circumstances of his next move do not seem to be recorded, but in 1913 he went to the Philippine Islands as Assistant Superintendent of Pest Control for the Bureau of Agriculture. Four years later he transferred to Port Moresby, New Guinea, as an expert for the Papuan Department of Agriculture.

In July 1917 Zimmer married Miss Margaret Thompson, who resided with him for several years in New Guinea, where at least one of their two children was born. Their son, Lawrence Thompson Zimmer, became a bio-physicist. The daughter, Ida Elizabeth Zimmer Sprague, majored in philosophy in her college career and is also the mother of three children.

Zimmer and his wife were a notably close and congenial couple. He never fully recovered from the shock and sorrow of her death in October 1945. It is strange that the same malady in the same locus—first diagnosed as "arthritis" of the hip—carried off wife and husband twelve years apart.

Information about Zimmer's official services in the Philippines and New Guinea is surprisingly scant, but his continuing or growing interest in birds is shown by the fact that he made important personal collections in both places. On Philippine birds he published two still valuable papers. His New Guinea specimens were never the subject of a similar report by him, but they were purchased by the American

JOHN TODD ZIMMER
1889-1957

Museum of Natural History, along with the Philippine collection, in time to be studied by Ernst Mayr while the latter was preparing his "List of New Guinea Birds."

Following the return from Papua to the United States, Zimmer spent a short period as assistant at the University of Nebraska Museum before he was called to join the staff of the Field Museum (now the Chicago Natural History Museum). Two of his eight years in Chicago were devoted to preparing the "Catalogue of the Ayer Ornithological Library," which was published in two volumes. This extremely useful work of reference is an example of the meticulous attention to scholarship and the book-lover's art with which Zimmer approached all research, whether bibliographic, nomenclatural, or taxonomic. While at Chicago he also took part in the Conover-Everard African Expedition and later in the Marshall Field Peruvian Expedition. His extensive report on the birds of the Peruvian expedition marked the beginning of his ultimate exhaustive study of the unrivaled avifauna of the South American continent.

Charles Hellmayr had been brought from Europe to Chicago to complete the "Catalogue of the Birds of the Americas," which had been initiated at the Field Museum by Charles B. Cory. In New York, Frank M. Chapman was looking for a properly qualified ornithologist to augment research on the vast neotropical collections possessed by the American Museum of Natural History, the definitive study of which had already been marked by Chapman's own monographs on the birds of Colombia and Ecuador. It was thus natural that he should turn to Zimmer, who had just passed forty years of age, and who in 1930 came to New York as Associate Curator of Birds. In 1935 he became Executive Curator, in 1942 Curator, and in 1954 Chairman, after the retirement of Robert Cushman Murphy from that post. Unfortunately, a decline in his health had set in before the final appointment, but he continued with unflinching and uncomplaining fortitude to come to the Museum as long as it was humanly possible. Later he carried on his work from his desk at home, and finally from a wheelchair.

To turn back twelve years, the sudden death of Glover M. Allen in 1942 left *The Auk* without an editor. James P. Chapin, then President of the American Ornithologists' Union, proposed his colleague John Zimmer for the post. Zimmer accepted and served for six years as the fourth editor of the journal, for which his broad knowledge of ornithological science, his familiarity with the historic literature gained during the compilation of the Ayer Catalogue, and his trained capacity for editorial work well fitted him.

Throughout twenty-seven years of service at the American Museum of Natural History, Zimmer applied himself primarily to the study of Peruvian birds. He published a series of systematic revisions of the avifauna of that country, and incidentally of many other parts of the American tropics. In connection with these studies he carefully examined allied populations from outside Peru, with the result that the papers of this series contain many revisions of wide-ranging polytypic species, invaluable to workers anywhere in the neotropics. His methodical listing of the localities of all specimens examined often recorded for the first time occurrences in areas far distant from Peru. At the time of his death no fewer than 66 of these publications had appeared. This is the accomplishment that brought him the award of the Brewster Medal in 1952, at which date the accompanying ascription noted that his papers "have embodied extremely thorough and sound taxonomic treatment of a large proportion of the genera of birds in South America. These reports are truly the foundation for the work of all other current students of the South American avifauna."

Zimmer formed a close working relationship with William H. Phelps, Sr. of Caracas, and twice visited that city to study the peerless Phelps Collection of Venezuelan birds. Many publications resulted from the collaboration of these two ornithologists. Zimmer also found a kindred spirit in the late James Lee Peters, and the two men were alike in their uncompromising insistence upon thoroughly substantiated systematic work. It was a rare compliment when Peters asked Zimmer to write the volume on the difficult Family Tyrannidae for his "Check-List of Birds of the World." During Zimmer's last year or two of full activity it was his custom to devote alternate weeks to the American flycatchers and to Peruvian birds. Needless to say, both occupations were interrupted, as his work had been in earlier years, by frequent requests of other colleagues for assistance and by pressing matters of Museum exhibition and administration. In the tidiness of all his data he showed attributes of the ideal museum curator.

As a world-traveler and an individual of dedicated leanings since boyhood, as well as one whose interests and training had embraced entomology, botany, and the study of vertebrates other than the birds that ultimately claimed his major attention, Zimmer was a widely-informed naturalist. To a surprising degree he knew the answers to many questions that stumped his colleagues. It is regrettable that his whole-hearted attention to exemplary systematic work prevented him from publishing a larger proportion of his broad knowledge of animal behavior, geographical distribution, and ecological relationships.

An excellent example of his experimental approach to bird-watching is offered by his discovery of the refractive adaptation in the sight of herons. While feeding small fish to young purple herons, Zimmer noticed that the captive birds "struck short" and hit the ground on the near side of the dead prey. Surmising the reason, he next immersed the fish under two or three inches of water, whereupon the herons struck and seized the food at the first attempt. The significance of this is that any bird with its eye in the air and its quarry in the water would of necessity aim at a visual point where there was no fish in order to compensate for the different refractive index of each medium.

Temperamentally, John Zimmer was both shy and self-contained. In the delivery of a scientific paper at a meeting he spoke freely and articulately, but in the associations of daily life he talked only when something needed saying. This did not inhibit the drily humorous comments he was apt to interject into group conversations of his fellows at the lunch table or in the Museum coffee room. Once in a while he might reach into the past and tell us of some adventure, perhaps one pertaining to travel on a motorcycle in the back country of Luzon. Such experiences, of which we heard only rarely, seemed far removed from the regulated life of the reserved, conservative, daily commuter between White Plains and Manhattan. No doubt, however, they were in part the source of the breadth and maturity that characterized his later accomplishments in research and administration.

In general, Zimmer was certainly much more a listener than a talker. Furthermore, although always friendly in his willingness to devote any amount of thought in response to a call for aid, he was at the same time a man who had few inclinations that could be called "social." He was, nevertheless a valued and faithful member of the Explorers' Club of New York. Of his avocational interests, or those pertaining to his home community, we knew relatively little. He had a taste for gardening, about which he would sometimes converse with those in sympathy. This was reflected also in a tray of small desert plants that was for years a feature of his office. Sometimes he would mention to one of us the satisfaction he had derived from a brief visit with his children and grandchildren. But the general impression he created at the Museum, particularly after he had lost his wife, was of a man of semi-recluse traits whose aim in life was consistently centered on the huge task of deciphering and spreading on the record the relationships of birds in the continent that has produced more families and species than any other.

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INTERSPECIFIC INTOLERANCE OF THE AMERICAN COOT IN UTAH

BY RONALD A. RYDER

Introduction

The American Coot (*Fulica americana*) is extremely territorial and vigorously defends its territory against not only other coots but also a wide variety of vertebrates. The effects of this interspecific intolerance upon waterfowl production were investigated, with particular emphasis upon comparative behavior, nesting and young-rearing success of coots and ducks. The following observations concern primarily the first aspect. Nesting and young-rearing success will be discussed in a later paper.

This study was financed through the Utah Cooperative Wildlife Research Unit, with the U. S. Fish and Wildlife Service, Utah Fish and Game Department, Utah State University, and the Wildlife Management Institute cooperating. Dr. Jessop B. Low assisted in the direction and supervision of the project.

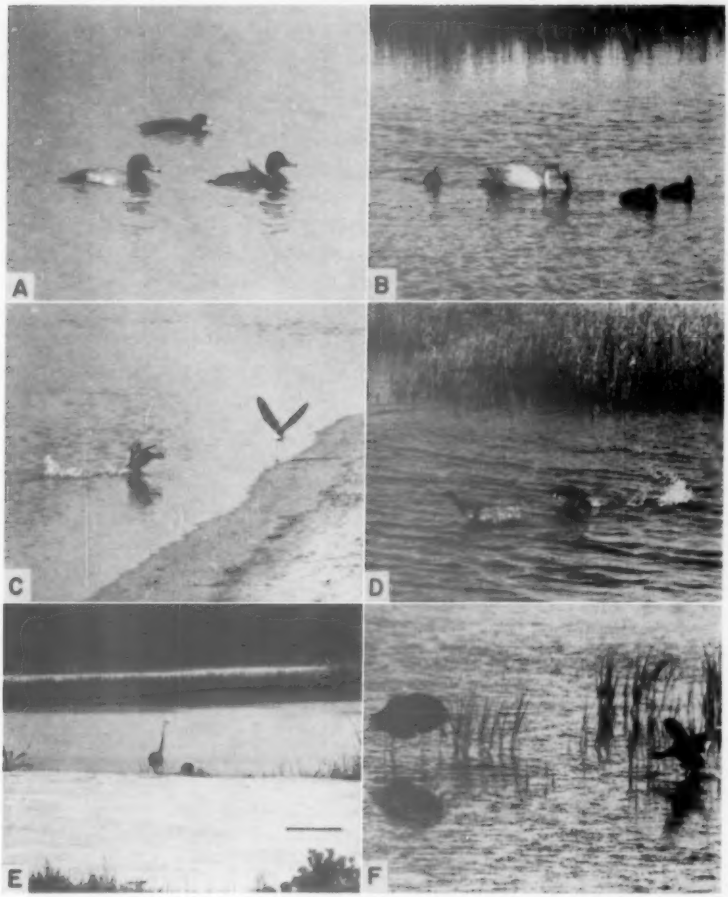
Observations were made at various marshes in northern Utah but primarily on Ogden Bay Refuge, one of six waterfowl management areas developed by the Utah Fish and Game Department. A detailed description and history of this important waterfowl area has been published by Nelson (1954). Most findings relate to five study areas, varying in size from 15 to 76 acres, three on Ogden Bay Refuge and two on the Bay View Club, two miles west of Westpoint in Davis

TABLE 1

General Description of Study Areas, Weber and Davis Counties, Utah

Study Area	Total Acreage[1]	Percentages[1]			Treatment Applied
		Open Water	Emergents	Upland	
Unit 3	76.4	45	49	6	Control, no treatment
Check Station					
N. Pond	17.3	21	48	31	Control, no treatment
S. Pond	14.8	16	46	38	Coots reduced by shooting and trapping
Westpoint					
N. Pond	48.0	38	13	49	Coots increased by introduction
S. Pond	44.5	28	28	44	Coot hatch delayed by nest destruction

[1] Based on planimetering cover maps prepared from aerial photos and ground inspection.



COOT INTERSPECIFIC CONFLICTS. A. Patrolling coot "herding" a pair of Redheads away from the vicinity of the coot's nest. B. Coot defending food source around Whistling Swan. C. Coot "splattering" at Black-necked Stilt. D. Coot "splattering" at a male Cinnamon Teal. E Coot "swanning" at a Great Blue Heron F. Coot "splattering" at White-faced Ibis.

County. Coots were reduced on the smallest area by shooting and trapping, while their hatch was delayed and reduced by systematic egg destruction on another area. Unsuccessful attempts were made to increase coots on a third area by introduction of wild-caught coots. A general description of these study areas and the treatments applied to each is given in Table 1.

Weekly behavioral observations of about four hours' duration were made from late March until mid-August during both years. These observations were from semipermanent blinds erected on three of the areas (Unit 3, Check Station North Pond, and Westpoint North Pond). Weekly censuses were made on all areas. Routine nesting surveys were also conducted, followed by frequent brood counts. A few of the coots discussed in this paper were marked with plastic neck tags such as used by Gullion (1951), while most were identified by their location on the areas and by the shape and size of their frontal shields. Sex determination was based upon voice differences,

TABLE 2

ESTIMATED BREEDING PAIRS ON STUDY AREAS, 1956 AND 1957

Species		*Unit 3*	*Westpoint*		*Check Station*		*Total*
			N. Pond	*S. Pond*	*N. Pond*	*S. Pond*	
Coot	1956	70	55	27	14	[1] 17	183
	1957	65	48	29	12	[2] 9	163
Mallard	1956	8	2	1	4	2	17
	1957	11	5	5	3	2	26
Gadwall	1956	4	2	1	1	0	8
	1957	3	1	1	0	1	6
Pintail	1956	1	0	0	0	0	1
	1957	1	0	0	1	0	2
G-w Teal	1956	1	1	0	0	0	2
	1957	0	0	0	0	0	0
B-w Teal	1956	1	1	0	0	0	2
	1957	1	1	0	0	0	2
Cin. Teal	1956	15	3	2	4	4	28
	1957	14	2	2	2	1	21
Shoveler	1956	1	1	0	1	0	3
	1957	1	1	0	0	0	2
Redhead	1956	30	12	3	9	0	54
	1957	26	10	6	5	2	49
Ruddy Duck	1956	3	5	5	2	2	17
	1957	3	3	2	2	1	11

[1] Coot population before control; after control 4 pairs estimated in 1956.
[2] Coot population before control; after control 5 pairs estimated in 1957.

while age determination was based upon plumage and leg color. The terminology used to describe various coot displays is, with few exceptions, that used by Gullion (1952).

BREEDING POPULATIONS

In addition to coots, the following ducks nested on the study areas: Mallard (*Anas platyrhynchos*), Gadwall (*Anas strepera*), Pintail (*Anas acuta*), Green-winged Teal (*Anas carolinensis*), Blue-winged Teal (*Anas discors*), Cinnamon Teal (*Anas cyanoptera*), Shoveler (*Spatula clypeata*), Redhead (*Aythya americana*), and Ruddy Duck (*Oxyura jamaicensis*). Table 2 summarizes the numbers of these birds estimated to have nested on the areas.

INTERSPECIFIC INTOLERANCE OF COOTS

Numerous references in the literature describe interspecific territorial displays and aggressions by both American Coot and European Coot (*Fulica atra*) (Table 3). These include attacks upon a variety of water birds, especially grebes and ducks, and even upon turtles, garter snakes and muskrats. Boyd (*in litt.*), writing of the Wildfowl Trust in Great Britain, said, "a few coots spend the winter with our captive waterfowl, and hold their own successfully with almost all species irrespective of size."

Some investigations have been conducted to determine the importance of this interspecific conflict. Munro (1937) concluded, "The size of duck broods is not conspicuously influenced by the presence of coots." Later Munro (1939) reported he found no direct evidence of coots attacking or molesting young ducks. R. Smith (1955), however, felt that the belligerence of territorial coots should not be overlooked as a factor possibly limiting loaf spots for breeding ducks. On his study areas at Ogden Bay Refuge, Smith found the coot dominant over all species of waterfowl with the exception of the Mallard and Canada Goose. He believed coots can greatly reduce available feeding areas for waterfowl. Sooter (1945) believed coot territoriality might be a factor in reducing the area of suitable nesting territories for other waterfowl, as well as limiting feeding of certain broods. Neither Hochbaum (1944) nor Low (1940 and 1941) reported any interference between coots and Canvasbacks (*Aythya valisineria*), nor with Redheads or Ruddy Ducks. Stevens (1947), referring to his Iowa studies, said, "There seemed to be no schism between coots and gallinules on the one hand and the diving ducks on the other." Harris (1954) however, believed that coots made small pot-

TABLE 3

SPECIES ATTACKED BY COOTS IN TERRITORIAL DEFENSE
(*Fulica americana* in North America, *F. atra* in Europe and Asia)

Species Attacked by Coot	*Areas and Authorities*
Mud turtle	California (Gullion, 1953)
Garter snake	California (Gullion, 1953)
Eared Grebe	New Mexico (Wetmore, 1920); Germany (Kornowski, 1957)
Red-necked Grebe	Germany (Kornowski, 1957)
Great Crested Grebe	Germany (Kornowski, 1957, and Heyder, 1911); England (Witherby, *et al.*, 1949)
Pied-billed Grebe	California (Gullion, 1953)
Little Grebe	England (Höhn, 1949, and Brown, *in litt.*); Germany (Kornowski, 1957)
"Ducks"	New Mexico (Wetmore, 1920); Scotland (Berry, 1939)
"Ducklings"	Oregon? (Job, 1915); Washington (Jeffrey, 1948, and Harris, 1954); England (Witherby, *et al.*, 1949)
Mallard	Oregon (Sooter, 1945); Washington, D. C. (Collins, 1944); California (Gullion, 1953); England (Boyd, *in litt.*, and Cramp, 1947); Germany (Kornowski, 1957, and Libbert, 1926)
Gadwall	Oregon (Sooter, 1945); Utah (R. Smith, 1955); Germany (Kornowski, 1957)
Pintail	Utah (R. Smith, 1955)
Common Teal	Germany (Kornowski, 1957); England (Brown, *in litt.*)
Blue-winged Teal	Utah (R. Smith, 1955)
Cinnamon Teal	Oregon (Sooter, 1945); Utah (R. Smith, 1955)
Shoveler	Utah (R. Smith, 1955); Germany (Kornowski, 1957, and Libbert, 1926)
Garganey	Germany (Kornowski, 1957)
Redhead	Oregon (Sooter, 1945)
Common Pochard	Finland (Nylund, 1945); England (Höhn, 1949)
Tufted Duck	England (Cramp, 1947); Germany (Kornowski, 1957)
Ruddy Duck	Oregon (Sooter, 1945); California (Gullion, 1953)
Ruddy Shelduck	England (Cramp, 1947)
Whooper and Mute Swans	England (Burkill, 1911)
Moorhen	England (Höhn, 1949, and Brown, *in litt.*); Germany (Kornowski, 1957)
"Long-legged waders and shore birds"	Utah (R. Smith, 1955)
"Small birds"	California (Gullion, 1953)
Yellow-headed Blackbird	California (Gullion, 1953)
"Other birds" (than coot)	North America (Blanchan, 1904); India (Stuart-Baker, 1929)
Muskrat	California (Gullion, 1953); Washington (Harris, 1954)

holes in Washington less desirable to duck broods and wrote, "It is suspected that the high breeding population of coots served to partially limit duck populations in the Potholes." Allen Smith (1956) has written in regard to his Alberta studies:

> "Since the start of this study in 1952, general field observations of coots and waterfowl on the Lousana area have led us to believe that the aggressive nature of the coot during all periods of the breeding season could not but adversely affect the duck population in coot habitats. Nevertheless, we have been able to collect no data to prove that this is so."

Apparently the coot territorial defense is not always impenetrable. Various authors describe finding coot nests parasitized by other birds such as the Common Gallinule (*Gallinula chloropus*) (Attwood, 1948), Redhead (Bryant, 1914) and Ruddy Duck (Low, 1941; Weller, 1956). Similarly, Delacour and Mayr (1946) and Goodall, *et al.*, (1951) mention the Black-headed Duck (*Heteranetta atricapilla*) parasitizing the nest of the Red-gartered Coot (*Fulica armillata*) in South America. Munro (1919) found Red-necked Grebes (*Podiceps grisegena*) nesting close to American Coot nests in British Columbia. In Europe, Kornowski (1957) noted Mallards, Common Pochards (*Aythya ferina*), Mute Swans (*Cygnus olor*), Black-headed Gulls (*Larus ridibundus*), and Great Crested Grebes (*Podiceps cristatus*) nesting in European Coot territories.

A total of 11 species of ducks, 16 other species of birds, one fish, one reptile and two mammals were seen pursued or threatened by coots on the Utah study areas. During the two years, 712 interspecific attacks or threats involving coots were recorded during 359 observation hours (Table 4). The intensity of these threats varied considerably, from simple "patrolling" by a coot causing a duck or grebe to leave the coot territory (Plate 20A), to actual fighting between ducks and coots, ibises and coots. (Words in quotations are used as defined and illustrated by Gullion, 1952, for stereotyped forms of coot behavior.)

Most species of ducks seemed to recognize and honor aggressive displays of the coot such as "patrolling" and "charging", but frequently coots resorted to "splattering" to drive ducks and other birds from their territories (Plate 20C, D and F). Coots were often seen "churning" at large adversaries, such as Great Blue Herons, which apparently would not retreat from "swanning", but which the coot feared too much actually to engage in fighting. In such cases, coots

TABLE 4

SUMMARY OF INTERSPECIFIC ATTACKS BY COOTS OBSERVED ON THE UTAH STUDY AREAS, 1956 AND 1957

Species	*Frequency of conflicts*			*Attacks/observation hour*		
	1956	*1957*	*Both Years*	*1956*	*1957*	*Both Years*
Carp	0	1	1	0	0.005	0.003
Turtle	0	2	2	0	0.009	0.006
Eared Grebe	0	4	4	0	0.018	0.011
Pied-b Grebe	23	18	41	0.166	0.082	0.114
White Pelican	0	1	1	0	0.005	0.003
Gr Blue Heron	1	7	8	0.007	0.032	0.022
Snowy Egret	7	8	15	0.050	0.036	0.042
B-c Night Heron	2	5	7	0.014	0.023	0.020
Wh-faced Ibis	27	75	102	0.195	0.341	0.284
Mallard	12	27	39	0.086	0.123	0.109
Gadwall	5	23	28	0.036	0.105	0.078
Pintail	3	18	21	0.022	0.082	0.059
G-winged Teal	3	9	12	0.022	0.041	0.033
Bl-winged Teal	1	11	12	0.007	0.050	0.033
Cinnamon Teal	48	45	93	0.339	0.205	0.256
Shoveler	2	9	11	0.014	0.041	0.031
Redhead	40	162	202	0.288	0.736	0.563
Com Goldeneye	0	2	2	0	0.009	0.006
Bufflehead	1	0	1	0.007	0	0.003
Ruddy Duck	12	45	57	0.086	0.205	0.159
Sora	0	1	1	0	0.005	0.003
Killdeer	0	2	2	0	0.009	0.006
Spotted Sandpiper	2	1	3	0.014	0.005	0.008
American Avocet	4	15	19	0.029	0.068	0.053
B-necked Stilt	2	2	4	0.014	0.009	0.011
California Gull	3	4	7	0.022	0.018	0.020
Franklin's Gull	1	0	1	0.007	0	0.003
Forster's Tern	0	4	4	0	0.018	0.011
Black Tern	1	1	2	0.007	0.005	0.006
B-billed Magpie	1	0	1	0.007	0	0.003
Y-h Blackbird	3	4	7	0.022	0.018	0.020
Muskrat	0	2	2	0	0.009	0.006
Weasel	0	1	1	0	0.005	0.003
Totals	203	509	712	1.463	2.314	1.985
Hours observ.	138.75	220	358.75			

would alternate "churning" with "swanning". Often when coots charged trespassing vertebrates which escaped by diving—such as younger coots, Ruddy Ducks, grebes and muskrats (*Ondatra zibethicus*)—the defenders "churned" directly over the point where the trespasser had dived. "Swanning" and "churning" were often accompanied by a guttural "growl," especially when in defense of young or nests.

Interspecific conflicts mainly occurred on water in close proximity to the nest platform and/or young but occasionally extended over

mudflats or solid land. Gullion (1953) observed that coots seldom pursued other coots on to land, but in Utah I frequently saw this behavior. Kornowski (1957) mentioned intraspecific but not interspecific pursuits over land.

Of the many birds noted in coot territories, Canada Geese (*Branta canadensis*) and White Pelicans (*Pelecanus erythrorhynchos*) were the only species consistently avoided by coots as if feared. However, on one occasion a coot was seen making a half-hearted charge at a pelican which threatened in return, causing the coot to swim away. Usually coots swam scolding into emergent cover when their territories were invaded by large flocks of fishing pelicans. Coots were observed driving from their territories flocks of as many as 17 White-faced Ibis (*Plegadis chihi*), 10 Mallards and 9 Shovelers.

Aggressive actions of coots against coots were observed each spring when field observations were commenced late in March. In 1957 coots were frequently observed "attending" Whistling Swans (*Olor columbianus*) at both Ogden Bay and Bear River Refuges during late March and throughout most of April. Not only did one to four coots circle about a feeding swan, picking up bits of debris churned up by the treading and dabbling of swans, but some coots even defended this source of food from Redheads (Plate 20B). Later in the summer coots attended Mallards, Pintails, and Redheads in a similar manner.

Intraspecific conflicts reached a peak about the last week of April, whereas interspecific conflicts were most frequent per hour of observation the first half of June in 1956 and the latter part of June in 1957. Admittedly, various factors influence the frequency of coot conflicts recorded. As the emergent vegetation increased in height with the progress of the season, it became increasingly difficult to confirm visually all coot conflicts detected aurally. Moreover, later in the season when there were more birds (diving ducks and ibises, in particular) moving through coot territories, there was more opportunity for conflicts.

Intraspecific conflict peaks seemed to correspond with the establishment of coot territories and the building of display and egg platforms. Interspecific territorial peaks were not reached until the young coots had hatched. Thus, in 1956 the peak coot hatch occurred in the week of May 13-19, the peak of interspecific conflict frequencies the first half of June. In 1957 the peak of coot hatchings occurred late in May, the peak of interspecific conflicts late in June. This is more or less in agreement with Gullion's (1953) California

findings. He found that ducks and other species were usually ignored until after the coot broods hatched. Sooter (1945), too, apparently noticed more interspecific conflicts after the coot broods had hatched.

COOT-DUCK CONFLICTS

Among the waterfowl there was considerable variation noted in the number of attacks by coots. Redheads were the duck most frequently noted in interspecific conflict with coots as regards actual attacks and threats. Over 40 percent of the coot-duck conflicts observed involved Redheads. Cinnamon Teal were second most frequently attacked, about 20 percent of the coot-duck conflicts; Ruddy Ducks were third, accounting for about 12 percent of the coot-duck conflicts. Of these three species, Redheads were most abundant on the study areas involved, Cinnamon Teal were next, but Ruddy Ducks ranked only fourth in abundance; Mallards were third.

Cinnamon Teal, Redheads and Ruddy Ducks were apparently in conflict with coots out of proportion to their abundance on the areas. Mallards, on the other hand, were not in conflict with coots as often as might be expected from their abundance. Many things other than the mere abundance of a species on the study areas apparently influenced the frequency of coot-duck conflicts, for example: 1) time of the breeding cycle at which contacts occurred, 2) activity of the ducks at the time of contact, and 3) size and aggressiveness of the ducks.

Coot-Mallard conflicts. The peak of coot-Mallard conflicts per unit time of observation during the nesting season occurred late in April, when most Mallard females on the study areas were laying or incubating. Most coots were just beginning to lay and mainly seemed to attack only those Mallards that ventured close to coot nests. Drake Mallards, in particular, were involved in these conflicts, as they loafed or fed near emergent vegetation, apparently awaiting their mates. Coots were not always successful in their Mallard encounters, losing six of the 39 coot-Mallard conflicts noted in the two years (Table 5). In contrast, Gullion (1953) observed Mallards to be the species most successfully attacked by coots on his areas. In Utah most of the Mallard courtship and pairing activities were completed by the time coots were establishing their territories. Coots might conceivably interfere with renesting success of Mallards which lost their first or earlier nest attempts. Mallard drakes desert their mates early in incubation and might be even more inclined to abandon a particular loaf spot if harassed by coots. However, even

into May and June a few Mallard drakes were still on station in the study areas. These males were probably able to mate with any hens which were unsuccessful in their earlier attempts.

Coot-Cinnamon Teal conflicts. The peak of coot-Cinnamon Teal conflicts occurred somewhat later than that for Mallards (in early May), but they were almost as frequent throughout the latter part of April. Coots dominated all of the 93 observed encounters with Cinnamon Teal except two, where female teals with broods drove coots away. Over half (47) of the conflicts involved mated pairs of teals, but almost as many (41) involved lone males. As with Mallards, most of these lone drakes apparently were awaiting their mates, who were laying or incubating nearby. R. Smith (1955) found Cinnamon Teal had the smallest home ranges and areas of intolerance within those ranges of the four species of dabblers he studied at Ogden Bay (Mallard, Shoveler, Gadwall and Cinnamon Teal). This was also true on the coot-waterfowl study areas. The pair bond in Cinnamon Teals is maintained longer after incubation has commenced than is true in Mallards; thus drake teals would seemingly be more available to insure the fertilization of hens attempting to renest. Here again, by harassing loafing drakes, coots might interefere with this function. Coots could conceivably have an even greater effect on teal, since they were much more successful in driving teal from their territories than Mallards. As were the Mallards, however, Cinnamon Teal were repeatedly seen on the study

TABLE 5

SUCCESS OF COOTS IN DRIVING DUCKS FROM THEIR TERRITORIES, 1956 AND 1957

Species	*No. of Conflicts*	*Percentage Outcomes*		
		Coots won	*Coots lost*	*Draw*
Mallard	39	82.0	15.4	2.6
Gadwall	28	100.0	—	—
Pintail	21	47.6	33.3	19.1
Green-winged Teal	12	100.0	—	—
Blue-winged Teal	12	100.0	—	—
Cinnamon Teal	93	97.8	2.2	—
Shoveler	11	100.0	—	—
Redhead	202	77.2	20.3	2.5
Common Goldeneye	2	100.0	—	—
Bufflehead	1	100.0	—	—
Ruddy Duck	57	80.7	19.3	—
All ducks	478	84.1	13.8	2.1

areas, week after week, frequenting approximately the same areas, occasionally getting too close to a coot nest or brood and then being charged and made to fly. Courtship activities of Cinnamon Teal and Shovelers seemed to evoke aggressive behavior in coots. Neck-bobbing and rather monotonous calling in these two species as several males swim around a female seems to attract the attention of territorial coots, which frequently would charge whole courtship parties. Kornowski (1957) reports similar unrest in European Coot territories caused by nuptial displays of courting ducks.

Coot-Redhead conflicts. Coot-Redhead conflicts were prevalent in late May and early June, when Redheads were actively nesting or seeking nests to parasitize. Most coots had broods at this time and were increasingly intolerant of all forms of bird life that entered their territories. Coots were less successful in their encounters with Redheads than with any other ducks nesting on the areas except Pintails. Both drake and hen Redheads often threatened and occasionally even fought coots that attempted to repulse them. Female Redheads with broods dominated every conflict with coots. In all, however, coots were successful in 156 (77 percent) of the 202 coot-Redhead conflicts observed. Unlike the dabblers previously discussed, Redhead drakes did not defend any definite portions of their home range except that immediately around their mate. When approached by another Redhead drake, pair or female, a male would display aggressiveness. Drake Redheads usually followed close behind their mates when the latter swam from open water into emergent cover as if seeking nest sites or nests to parasitize. When attacked by defending coots at such times, the drakes usually brought up the rear in retreat and often threatened or repulsed the coot charges. Several instances of actual fighting between coots and Redheads were noted. Redheads, however, were exceptionally persistent in returning and re-attempting passage through coot territories. For example, on May 16, 1957, a pair of Redheads (or possibly two pairs were involved) was driven from a coot territory on the Check Station North Pond area nine times in four hours of observation, returning eight times at intervals of five to 96 minutes! Similar attempts may have continued after observations were terminated that day.

Coot-Ruddy Duck conflicts. Coot-Ruddy-Duck conflicts were noted somewhat later in the nesting season than were those with Mallards, Cinnamon Teal or Redheads. Two peaks of frequency of attacks were noted, one in mid-May and a second in early July. The first came at a time when many coots had young, whereas Ruddy Ducks

were just seeking nesting sites and a few beginning to lay. These early encounters were dominated by coots. Unlike the ducks previously mentioned, Ruddy Ducks commonly escaped by diving and swimming away underwater. A coot would usually churn over the submerged Ruddy and on occasions actually scratch and peck the duck's back. These earlier encounters mainly involved lone drakes and pairs. Courting parties of Ruddy Ducks did not seem to evoke coot attacks as regularly as did similar antics in teals and Shovelers, probably because Ruddy groups were usually smaller and remained in one place less time. Female Ruddies pursued by one or several drakes swam considerable distances diving and surfacing, usually passing through several coot territories in rapid succession. Teals and Shovelers, on the other hand, remained in relatively small areas and rarely dived. As pointed out by Gullion (1953), three or four dives on a Ruddy Duck's part would usually discourage an attacking coot. However, on the Check Station North Pond, in particular, coots were observed pursuing Ruddy Ducks persistently, and waiting, dive after dive, for the duck to surface. The Coot-Ruddy Duck conflicts which occurred later in the season mainly involved Ruddy hens with broods, which often initiated the aggressions. In all observed instances the Ruddy hen, whether the aggressor or not, dominated the coots.

Coot conflicts with other species of ducks. In addition to the previously mentioned ducks, Gadwalls, Pintails, Green- and Blue-winged Teal, and Shovelers were occasionally charged by coots on the study areas. With the exception of those involving the Pintails, most of these conflicts took place during the early part of the ducks' breeding cycles. Small parties of courting dabbling ducks were frequently dispersed by territorial coots. In one instance, copulation in a pair of Gadwalls was disrupted by a defending coot. On other occasions copulation of Mallard and Redhead pairs took place in coot territories without interference. Coots may cause some disruption of the normal breeding sequence of ducks, but it is doubtful that this is of any great consequence. Only a few attacks by coots were noted against species of ducks not nesting on the study areas. Once a coot charged a male Bufflehead (*Bucephala albeola*) that had been displaying in the vicinity of the coot's nest. A drake Common Goldeneye (*Bucephala clangula*) was seen on the Westpoint North Pond throughout much of the summer of 1957. It was in poor plumage as early as May and apparently was crippled. Twice in separate weeks, a coot (or coots) drove the loafing goldeneye off a bare spit of land at least 50 yards from any emergent cover.

Most Coot-Pintail conflicts occurred after June 15, following the first arrivals of the northern birds that congregate in Utah marshes for their annual molt. Many of these conflicts involved adult or nearly grown coots that gathered about up-ending Pintails, picking up bits of aquatic vegetation the ducks tore loose from the pond bottoms. In some instances the Pintails drove the coots away, or a coot and a Pintail threatened each other but neither gave ground. Coots with small young frequently drove feeding Pintails out of the coots' territories.

Interspecific conflicts of ducks and coots during brood rearing. A few conflicts between coots and ducks with broods were noted in both 1956 and 1957. In all, 16 such conflicts were seen (Table 6), comparatively few considering the 111 different observations made from blinds of duck broods in coot territories. Eleven of the 16 conflicts were initiated by the duck hens involved. Cinnamon Teal, Redheads and Ruddy Ducks were seen driving coots away from the vicinity of their ducklings.

On one occasion, a Redhead hen leading one duckling drove a female coot off of a loaf site. Later the Redhead permitted the coot and one of her young to preen on the same loaf site but threatened them frequently, keeping them at the other end. Another time, a female Ruddy Duck with 11 downy young chased two immature coots out of the water on to the beach when they approached her brood too closely. Five different observations were made of coots attacking duck broods. In only three of these events were coots successful, twice against motherless Ruddy Duck broods and once against a

TABLE 6

COOT-DUCK BROOD CONFLICTS ON ALL AREAS, 1956 AND 1957 COMBINED

Species	*Total brood-observation hours*[1]	*Coot-duck conflicts noted*	*No. conflicts per brood-observ. hour*
Mallard	28	0	0
Cinnamon Teal	16	2	0.125
Pintail	16	0	0
Gadwall	36	0	0
Shoveler	3	0	0
Redhead	157	5	0.032
Ruddy Duck	113	9	0.080
All ducks	369	16	0.043

[1] One brood-observation hour equals one brood observed for one hour or two broods observed for one half-hour, etc.

Ruddy Duck hen and brood. Twice female ducks were seen to repulse coot attacks. Most coots, with or without young, seemed to give wide berth to ducks with broods.

Kornowski (1957) reported similar dominance of ducks with broods over territorial European Coots. H. Hays (*in litt.*) noted female Ruddy Ducks with broods threatening coots. Boyd (*in litt.*) told of seeing European Coots attack Mallard ducklings but concluded, "losses from such attacks must have been unusual." Sooter (1945) observed coots attacking Gadwall and Ruddy ducklings in Oregon but noted that coots were usually repulsed when the broods were accompanied by hens. In Washington State, Jeffrey (1948) and Harris (1954) both reported coots pursuing duck broods. Jeffrey (1948) told of mother ducks repulsing such attacks and commented that he had never observed any damage inflicted on young ducklings by attacking coots. Harris (1954) said of coot attacks on duck broods: "In most instances, the attending mother quickly led the brood away from the antagonists." Attacks of captive coots on ducklings have been reported by Collins (1944) and Job (1915).

Coot Conflicts with Vertebrates other than Ducks

A wide variety of aquatic and marsh birds used the study areas during the coot nesting season, and, as might be expected, several species were occasionally attacked by territorial coots. The various long-legged waders were most abundant and much inclined to enter coot-defended areas in their feeding. White-faced Ibises were frequently subjected to aggressive coot displays. This was undoubtedly because of their abundance (an estimated 10,000 ibises nest in the Ogden Bay-Howard's Slough area) and their habit of feeding along the edges of emergent vegetation. Then perhaps their dark plumage and white faces may act as releasers, somewhat resembling the dark shapes and white frontal shields of coots. At any rate, next to the Redhead, more coot interspecific conflicts involved ibises than any other species.

The various herons—Great Blue Heron (*Ardea herodias*), Snowy Egret (*Leucophoyx thula*) and Black-crowned Night Heron (*Nycticorax nycticorax*)—were also attacked by coots. Many of the coot-heron conflicts were obviously parental defenses of young. American Bitterns (*Botaurus lentiginosus*) were rather rare on the study areas and only once observed to influence coot-waterfowl behavior—a low-flying bittern quite innocently frightened coot and duck broods on the Check Station North Pond, causing the young birds to flee for cover.

Three grebes were fairly common at Ogden Bay Refuge and vicinity during the waterfowl nesting season. Western Grebes (*Aechmophorus occidentalis*) nested on the larger bodies of water. Eared Grebes (*Podiceps caspicus*) were very abundant during the spring migration, although none was known to have nested in the study areas. Pied-billed Grebes (*Podilymbus podiceps*) were common and nested in all of the study areas. Western Grebes were observed pursuing Eared Grebes but seemed to feed in more open water than that frequented by territorial coots and, perhaps for this reason, were never observed in conflict with coots. Coots rarely drove Eared Grebes from coot territories but often were seen in conflict with Pied-billed Grebes, especially in close proximity to the latter's nests. Pied-billed Grebes are particularly pugnacious in the defense of their nests, not only against others of their kind but against various ducks and coots. Unlike coots, Pied-billed Grebes seemed more aggressive during incubation than following hatching but did defend their young to some extent. Like coots, both sexes of Pied-billed Grebes shared in defense of their nesting territory. Of all the vertebrates observed in conflicts with coots, adult Pied-billed Grebes seemed to be the most successful in repulsing coot attacks or, more often the case, winning those attacks they initiated. Juvenile and immature grebes, in contrast, were completely dominated by adult and nearly grown coots, in either territorial or neutral waters.

Many species of shorebirds frequented the study areas in migration, and several remained to nest each summer. Attacks by coots were noted against Killdeer (*Charadrius vociferus*), Spotted Sandpiper (*Actitis macularia*), American Avocets (*Recurvirostra americana*), and Black-necked Stilts (*Himantopus mexicanus*) in approximate proportion to their numbers on the study areas. With the exception of the avocets, all seemed to be easily ejected from coot territories or from stretches of beach upon which territorial coots fed. Near their nests, however, avocets were very belligerent and would mob large birds such as gulls, herons and Marsh Hawks (*Circus cyaneus*). An occasional avocet would repulse a coot charge even when feeding in a coot-defended area. One pair of avocets was observed escorting their four small chicks as they swam across a small cove of the Westpoint North Pond. The adult avocets mobbed a pair of coots and their young and made another adult coot dive. In all, the avocets led their brood unmolested through at least two coot territories.

Both Soras (*Porzana carolina*) and Virginia Rails (*Rallus limicola*) were often heard although only occasionally seen on the study areas. In spite of being rather close relatives of the coot, these rails did not

seem to have very similar habits and were not often in situations for possible conflicts with coots. Only once was a coot (a nearly grown juvenile) seen to charge a Sora, one which ventured into a coot feeding area.

The various gulls and terns were attacked by coots in apparent defense of their broods. The single attack against a surfacing carp (*Cyprinus carpio*) seemed to be in the same category, whereas the attacks against a turtle seemed to be mere curiosity on the part of some juvenile coots. It is interesting to note that native turtles are unknown in the Great Salt Lake Basin (Woodbury, *in litt.*). A small turtle seen on the Check Station North Pond for several weeks in 1957 was most likely an escaped or released "pet," possibly from Ogden via the Weber River or irrigation canals to the east of the refuge.

Parental Defense by Coots of the Brood

Coots were observed to defend their young actively from various possible predators and harassment by other coots. Feigning or tolling, which were commonly observed with ducks, were never seen with coots. On at least six occasions adult coots defended against California Gulls (*Larus californicus*) obviously trying to grab the coots' young. This defense consisted primarily of swanning, churning and growling, but in two instances one adult coot splattered at a gull as it hovered over the coot's brood. When directly under the gull, the coot stopped and held its head aloft in an apparent parrying threat at the gull overhead. In none of these cases did the gulls succeed in capturing a coot chick during the time the observer was in the blind. As the observer had been in the blind more than half an hour prior to these attacks, it seemed unlikely that they were influenced particularly by human interference.

Similar parental defense of broods by adult coots was noted against Franklin's Gulls (*Larus pipixcan*), Forster's Terns (*Sterna forsteri*), Black Terns (*Chlidonias niger*), Black-crowned Night Herons, Great Blue Herons, Snowy Egrets, White-faced Ibises, and a long-tailed weasel (*Mustela frenata*). In these examples, the marsh birds were usually charged after they approached a coot brood which became frightened and fled crying for cover. Crying of young coots when threatened or pecked by adult coots other than their parents seemed to evoke similar parental defense. In only one of the above-mentioned cases did the repulsed marsh bird seem to be definitely trying to catch a young coot. Some 50 minutes after entering the Unit 3 blind on August 2, 1956, the observer saw a parent coot splatter at a Black-

crowned Night Heron that waded near the coot's young. During the next 20 minutes, the adult coot twice repulsed the heron, which flew only a few yards, alighted and waded slowly back toward the brood. Eventually much splattering and growling was heard. This time the heron flew away with a struggling coot chick in its bill. The coot continued to feed two young chicks (about one-week old) in the same area the remainder of the observation period. Coot defense threats against a weasel were observed from the same blind approximately one year later. Two coots from adjacent territories were peacefully feeding three and four young in front of the blind when one parent became alarmed and started giving warning calls. One brood fled for cover immediately, while the other seemed alert but remained near their parent. Both adults swam toward the dike upon which the blind was located. Within a few feet of the dike they paused, "swanning" and "growling" at a weasel apparently hunting along the dike. The weasel seemed to pay little attention to the coots, which swam parallel to it as it moved along the dike. In a few minutes the weasel disappeared from sight over the dike, and the coots resumed feeding their respective broods.

INTERSPECIFIC CONFLICTS INVOLVING SPECIES OTHER THAN COOTS

It should not be implied that the coot was the only species on the study areas which displayed interspecific territorial intolerance of ducks. Mallard drakes were seen to defend against Pintail drakes; Blue-winged Teal and Cinnamon Teal drakes against one another. A Ruddy Duck drake chased a Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) along the edge of the Westpoint North Pond. Pied-billed Grebes were seen charging Red-breasted Mergansers (*Mergus serrator*), Mallard, Redhead and Ruddy Duck adults, as well as Ruddy ducklings and Eared Grebes. Three different times avocets were observed pursuing Gadwalls, and once a Blue-winged Teal. Several instances were noted of ducks with broods defending against other ducks.

Interspecific territorialism seemed rather common among the nesting shorebirds. Willets (*Catoptrophorus semipalmatus*) chased Long-billed Curlews (*Numenius americanus*); avocets chased stilts. An incubating Killdeer periodically drove Spotted Sandpipers and avocets away from its nest. Various species of birds united to mob larger birds and mammalian predators. Black, Forster's and Common Terns (*Sterna hirundo*) harassed flying herons. Redwinged Blackbirds (*Agelaius phoeniceus*) mobbed Marsh Hawks and Short-eared

Owls (*Asio flammeus*) and united with avocets and Yellow-headed Blackbirds to torment a prowling weasel.

Although interspecific intolerance was apparent in several species of birds, it was most often and consistently displayed by the coot.

Responses by Coots to Decoys

At various times, efforts were made to evoke interspecific aggressions of coots against a pair of Redhead decoys. No interspecific intolerance was noted, although most coot pairs so tested defended against coot dummies. Live Redheads in turn responded to the duck decoys, but no interspecific behavior was evoked.

Conclusion

Most conflicts of coots with diving ducks seemed to involve feeding areas and nesting and brooding platforms, while conflicts with dabbling ducks seemed concerned with loaf sites and feeding areas. This interspecific territoriality of coots seems to have had very little effect upon duck nesting. Some ducks may have been excluded from nesting habitat by coots, but others were able to use abandoned coot platforms and nest in open emergents where they otherwise could not have done so.

Coots occasionally disrupted duck courtship temporarily and, more rarely, copulation. Even the frequently attacked Cinnamon Teal drakes usually returned to loaf sites from which coots had driven them. Interspecific territorial defense by coots was most pronounced following hatching. Although coots occasionally attacked ducks with broods, female ducks with young more often dominated coots, even within the latters' territories. Several predators which feed upon eggs and young of both coots and ducks were attacked by coots. These attacks against common enemies are believed to benefit ducks nesting and rearing their young in the vicinity of territorial coots.

Summary

The American Coot actively defends an area centered about its nest against ducks and other vertebrates, as well as against other coots. In all, 11 species of ducks, 16 other species of birds, one fish, one reptile and two mammals were seen pursued or threatened by coots. In Utah, Cinnamon Teal, Redheads and Ruddy Ducks were attacked by coots out of proportion to their abundance, whereas Mallards were attacked less frequently. The aggressiveness of coots is believed not to have an adverse effect on duck nesting, for predators are kept away and abandoned coot platforms supply nesting sites.

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PINK-HEADED DUCK—INFORMATION WANTED

Our Corresponding Fellow, Sálim Ali, of the Bombay Natural History Society, 91 Walkeshwar Road, Bombay 6, India, wishes information on any specimens existing in public or private museums of the probably extinct Pink-headed Duck (*Rhodonessa caryophyllacea*). The provenance of specimens and any other data on the original labels will be welcome.

HYBRIDIZATION IN THE BUNTINGS (*Passerina*) OF THE GREAT PLAINS

BY CHARLES G. SIBLEY AND LESTER L. SHORT, JR.

INTRODUCTION

The Indigo Bunting (*Passerina cyanea*) breeds over most of eastern North America from southern Canada to the Gulf of Mexico and from the Great Plains to the Atlantic. The Lazuli Bunting (*P. amoena*) occupies the western complement of this range, breeding mainly west of the Great Plains from southern Canada to northern New Mexico and central Arizona and to the Pacific coast (Fig. 1).

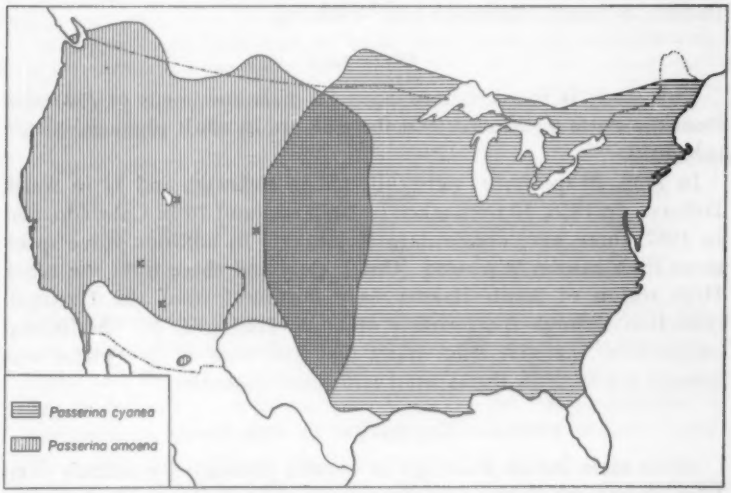

FIGURE 1. Breeding ranges of *Passerina cyanea* and *P. amoena* showing the area of overlap. Several western records of *cyanea* mentioned in the text are indicated by an X.

Both forms occur in brushy vegetation and along the edges of woodland. Their songs and calls, general behavior, and nests and eggs are extremely similar or identical. The adult males differ in color but the females are nearly indistinguishable.

The two forms were, until recently, isolated from one another by the unsuitable grassland habitat of the Great Plains. This isolation had endured at least since the Pleistocene when the glaciers divided the ancestral population as they did the populations of many other

groups of birds with similar eastern and western representatives today.

With the advent of agriculture in the plains during the past century there have been profound changes in the distribution of vegetation, and hence in the distribution of birds. The planting of trees and shrubs has greatly increased the favorable habitat for woodland and brush-dwelling species (see discussion by Sibley and West, 1959). As a result the two buntings have extended their ranges and the secondary contact between them has become extensive over a broad area in the Great Plains (Fig. 1). Because reproductive isolating mechanisms had not evolved by the time the extrinsic barrier was broken down, the two buntings have interbred. The present paper is a study of the hybridization which is now occurring in the area of overlap in South Dakota, Nebraska, Colorado and Wyoming.

MATERIALS

This study is based mainly upon 95 male specimens of *Passerina* from the states mentioned. Of these 58 are in adult plumage, 37 are subadults.

In 1955, 29 specimens were collected in Nebraska and 31 in South Dakota. In 1956, 10 were taken in Nebraska and 16 in Colorado, and in 1957, three were obtained in Nebraska. In addition three specimens from eastern Wyoming (Crook Co.) and three from the Black Hills region of South Dakota were borrowed from the Pettingill collection through the courtesy of O. S. Pettingill, Jr. Additional comparative material from states east and west of the plains was already available in the Cornell University collection.

PLUMAGE CHARACTERS OF THE MALES

Adult male Indigo Buntings in nuptial plumage are entirely deep blue above and below, the crown somewhat darker and the rump lighter than other areas. Males in their first nuptial plumage are distinguished by having *brown* primary coverts. In adult males the primary coverts are black, edged with blue. Most first year males also have some white on the lower abdomen. This white area is variable in size, sometimes extending beyond the legs but never as far forward as the breast.

The adult male nuptial plumage of the Lazuli Bunting is light turquoise blue above, the crown and rump being nearly concolor with the back. The abdomen and lower breast are white and a band of rusty (cinnamon) brown extends across the breast and down the sides. Two conspicuous white wing bars are present.

THE ANALYSIS OF HYBRIDS

When two forms differing in several characters interbreed it is usually possible to identify the parental source of a given character in the offspring. Variation in backcross products can be analyzed using a "hybrid index". This method has been described and utilized frequently in the past few years (Sibley, 1950; 1954; Sibley and West, 1958; Dixon, 1955) and was originally developed by Anderson (1949) during studies on plant hybrids.

The hybrid index is simply a synoptic description of the observed phenotypes. It is determined as follows. The principal characters by which the two parental forms differ are determined (see Table 1).

TABLE 1

DIFFERING COLOR CHARACTERS OF ADULT MALE INDIGO AND LAZULI BUNTINGS

	P. cyanea	*P. amoena*
1. Crown color	Deep blue-violet	Turquoise blue
2. Rump color	Azure blue	Turquoise blue
3. Wing bars	Absent	Present
4. Abdomen and lower breast	Blue	White
5. Breast band	Absent	Present

One pure parent is scored "0" on all characters. The hybrid characters are assigned as many values as there are discernible intermediate types and the other pure parent is given the character score at the upper end of the resulting scale. Values for each character of a specimen are determined and the summation of character scores is the hybrid index for the specimen (see Table 2).

For two of the five characters (crown and rump) only one intermediate color type was found in the hybrids. For the other three characters (wing bars, underparts, breast band) three gradations could be easily separated. Characters expressed as in eastern (*e.g.* New York) *P. cyanea* were assigned a score of "0". Those expressed as in western (*e.g.* California) *P. amoena* were scored "2" for crown and rump color and "4" for wing bars, underparts and breast band. The following table provides synoptic descriptions of the hybrid recombination types for each of the five characters in adult males (Table 2).

The subadult males presented a slightly different problem. In the first nuptial plumage males of *cyanea* normally retain some white feathers on the abdomen. However, because they retain the brown

TABLE 2

HYBRID INDEX VALUES OF COLOR CHARACTERS

Crown:	0 = deep blue, as in pure *P. cyanea.* 1 = intermediate between deep blue and turquoise blue. 2 = turquoise blue, as in pure *P. amoena.*
Rump:	0 = deep blue, as in pure *P. cyanea.* 1 = intermediate between azure blue and turquoise blue. 2 = turquoise blue, as in pure *P. amoena.*
Wing Bars:	0 = absent, as in pure *P. cyanea.* 1 = slight indication of wing bars. 2 = intermediate between the two extremes. 3 = wing bars nearly as complete as in *P. amoena.* 4 = two white wing bars, as in pure *P. amoena.*
Abdomen and Lower Breast:	0 = blue, as in pure *P. cyanea.* 1 = approximately one-fourth of the area white. 2 = approximately half of the area white. 3 = approximately three-fourths of the area white. 4 = white, as in pure *P. amoena.*
Breast Band:	0 = absent, as in pure *P. cyanea.* 1 = a slight tinge of rusty color on the breast. 2 = intermediate extent of rusty color on breast. 3 = breast nearly as extensively rusty as in *P. amoena.* 4 = rusty brown breast band as in pure *P. amoena.*

primary coverts of the juvenile plumage until the first post-nuptial molt, such birds are easy to age. Adults have black primary coverts. We have segregated our specimens into adults and subadults on the basis of the primary coverts. In the adults the color of the abdomen is scored as in Table 2. For subadults this character is omitted because it would not be possible to decide whether white in the abdomen was the result of immaturity or of hybridization with *amoena.* Thus adult males of pure *amoena* have a summated score of "16" (=2+2+4+4+4) and the subadult males have a summated score of "12" (=2+2+4+4). Hybrid scores range between "0" and "16" for adults and "0" and "12" for subadults.

In the hybrids, *cyanea* and *amoena* characters occur in many recombinations. Many specimens were found to be like one of the parental types except for one or two characters. In otherwise pure *amoena* the wing bars may be basally dark or tinges of violet in the crown or azure in the rump may occur. The breast band may be incomplete and the underparts clouded with blue. In otherwise pure *cyanea* the influence of *amoena* genes is indicated in adults by the presence of white on the underparts, rusty brown feathers in the

breast region, traces of wing bars and tinges of lighter blue on the crown and rump.

FEMALES

Only five females were collected during the three summers of field work. This small number was the result of selective collecting of males when given a choice, and the fact that the females are relatively inconspicuous.

These five birds seem to be *P. amoena,* although some may be hybrids. The fact that we cannot distinguish hybrid females helps to emphasize the similarity of the females of *cyanea* and *amoena.* The same situation occurs in two other groups which hybridize widely across the Plains, namely, the Baltimore and Bullock's Orioles (*Icterus g. galbula* and *I. g. bullockii*) and the Rose-breasted and Black-headed Grosbeaks (*Pheucticus ludovicianus* and *P. melanocephalus*). In these two, the males are strikingly different in color, the females extremely similar.

HISTORY OF THE SITUATION

As previously mentioned the modifications of the plant environment by human land-use activities have permitted the two buntings to extend their ranges and to overlap. In 1900, Burnett reported a spring flock of migrant Indigo Buntings in Colorado and expressed the opinion that habitat changes would permit the species to move westward. This prophecy has been amply vindicated by breeding records of the Indigo Bunting in Colorado in 1954 (Baily) and 1955 (Hering). In the Cornell University collection there is an adult male bunting (No. 21594) taken by J. D. Webster in Weber County, Utah, on August 12, 1945 (see map, Fig. 2). The specimen was indexed at "14", appearing like *amoena,* but with traces of *cyanea* in the restriction of the wing bars and the intermediate rump color. Wells (1958) has found Indigo Buntings apparently breeding in Washington County, Utah. Dr. William H. Behle informs us that Indigo Buntings are "exceedingly rare in Utah and are known only from the extreme southwestern part of the state."

A pair of apparently pure Indigo Buntings was found breeding at 4875 feet elevation near Flagstaff, Arizona, by Dearing and Dearing (1946). Lazuli Buntings were found nearby. A male Indigo Bunting was found mated with a female Lazuli Bunting in Soledad Canyon, Los Angeles County, California, by Bleitz (1958) in June, 1956. The nest of this pair contained two bunting eggs and a cowbird egg.

Incubation was apparently normal, but the eggs did not hatch. In June, 1957, a male Indigo Bunting was again observed in the same area (Bleitz, *loc. cit.*). This bird was singing but apparently was unmated when secured as a specimen on June 10. The specimen was examined by us and found to be an adult male which shows possible effects of hybridization in the lightness of the rump color and in the length (69.1 mm. chord) of the wing, which is intermediate. The tarsal length (17.2 mm.) is also intermediate, although the difference between the two species in this measurement is so small as to make this intermediacy unimportant. In other measurements (bill 7.7 mm., tail 52.2 mm.) and in the other color characters the specimen is similar to eastern *cyanea*. Another recent western record of *cyanea* is that of Boag (1958) who recorded two male Indigo Buntings singing in an area where Lazuli Buntings are noted as "common". This was 20 miles west of Turner Valley at the base of the Rocky Mountains in southwestern Alberta. One male was taken, and the specimen was obtained from Mr. Boag for examination. The specimen proved to be a subadult and showed no indications of hybridization. Measurements of the specimen (Univ. Alberta collection, No. 929) were as follows: wing length 66.1 mm., tail length 50.7 mm., bill length 7.8 mm., and tarsal length 17.8 mm.

Visher (1909) found Indigo Buntings breeding in the Black Hills of South Dakota and our own work indicates that *cyanea* may breed in eastern Wyoming. It should be pointed out that all recent records of *"cyanea"* west of the Plains are likely to be hybrids and that sight records are not satisfactory as the basis for records of "pure" Indigo Buntings in such areas.

The eastward movement of the Lazuli Bunting has also been documented. In 1888, Cooke found Lazuli Buntings in the summer at Vermillion, southeastern South Dakota. The first definite published evidence of *amoena* deep within the normal range of *cyanea* was the first hybrid taken by Breckenridge (1930) along the western border of Minnesota (Marshall Co.) on June 26, 1929. A second hybrid was collected in Cherry County, Nebraska on June 1, 1932 by Youngworth (1932). On July 4, 1933, a pair of *amoena* was found at Yankton, in southeastern South Dakota (Youngworth, 1934), and in June 1935, a male Lazuli was seen in Day County in northeastern South Dakota (Youngworth, 1935). The dates indicate that these birds were probably on their breeding grounds.

The Lazuli Bunting was recorded as a spring migrant at Hastings, Nebraska at least as early as May 7, 1933 (Swenk, 1933). In May,

1938, a "wave" of migrating Lazuli Buntings was recorded at Hastings (Staley, 1938; Jones, 1938). The first record near Omaha was on May 11, 1940 (Nebraska Ornithologists' Union, 1940) and on May 29, 1940, Whelan (1940) found the species near Lincoln. The second record east of Lincoln was at Omaha on May 21, 1944 (Haecker, 1944). The reports of spring migrants at Hastings were regular during the years since approximately 1933, as indicated by the annual reports published in the Nebraska Bird Review. In 1945 a dead Lazuli Bunting was found in Lincoln on May 6 (Jones, 1945) and the editor noted in connection with the record that, "In recent years reports of Lazuli Buntings in eastern Nebraska have become more frequent."

In spite of these numerous records of migrants there have been no breeding records of *amoena* yet reported in eastern Nebraska although we have found indications of hybridization as far east as Blair on the eastern border and at Crete, near Lincoln. It seems probable that the *amoena* which migrate through eastern Nebraska mostly swing westward before stopping to nest. In North Dakota the easternmost record obtained by Pettingill and Dana (1943) was a pair at Kenmare, Ward County, on June 19. Tordoff (1956) indicates that the Lazuli Bunting is a common transient and probably breeds in extreme western Kansas, but there are no actual nesting records. It is rare in eastern Kansas on migration.

For western Oklahoma there is again evidence of hybridization. Sutton (1938) states that in the same region in which hybrids between the Baltimore and Bullock's Orioles were collected, the Indigo Bunting and the Lazuli Bunting "were actually found to be inter-breeding."

THE ANALYSIS OF COLOR

Each of the 95 male specimens was indexed by the method previously described. Twenty-four were indexed at "0" as phenotypically pure *P. cyanea* and six were indexed as pure *P. amoena*. The remainder, more than two-thirds of the total, showed evidence of hybridization. The maps, Figures 1 and 2, indicate the distribution of hybrids and pure types.

Pure *cyanea* were obtained as far west as Crook, Colorado, on the South Platte River, at Valentine, Nebraska, on the Niobrara River, at Willson, Crook County, Wyoming, and at Rapid City, South Dakota.

Pure *amoena* were found at Rapid City, Mobridge, and Bridger Creek in South Dakota and at Chadron, Nebraska. Previously cited

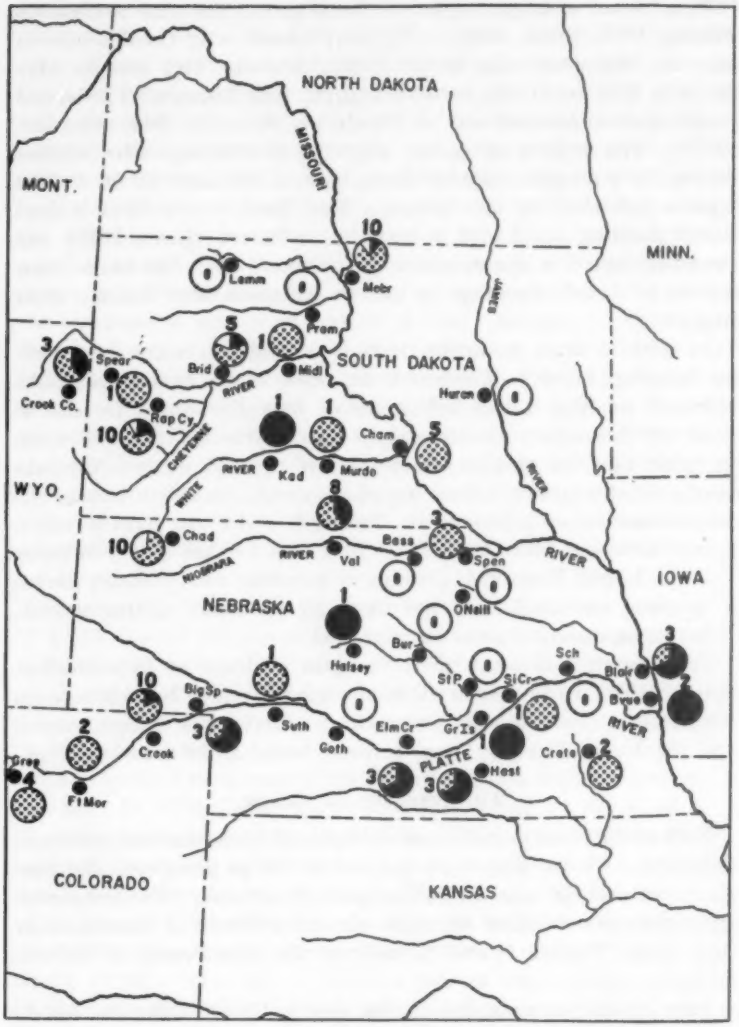

FIGURE 2. Map of the Central Plains showing collecting localities mentioned in the text. Names of the localities are abbreviations and names of nearby towns; exact locations are described in the text. Small black circles indicate the stations. The large circles contain a "0" if no buntings were taken. Numbers beside the large circles indicate the number of specimens. The proportions of pure *cyanea*, *amoena* and hybrid specimens are shown in the larger circles by black, white and dotted areas respectively.

records of probable breeding birds in eastern South Dakota, the hybrid from western Minnesota (Breckenridge, 1930) and our evidence of hybridization at Blair and Hastings, Nebraska, indicate that the zone of overlap between *cyanea* and *amoena* is possibly as much as 400 miles wide in Nebraska. As will be seen from the data the buntings occur in small, discontinuous populations because their habitat occurs in this pattern and, although hybridization is extensive, pure types of both parental forms are found throughout the overlap zone.

In the following section the localities at which specimens were collected will be considered individually.

The Platte River Transect and Southern Nebraska

During June and July, 1956, ten localities, spaced at approximately 50 mile intervals along the Platte and South Platte rivers of Nebraska and Colorado, were visited. These localities spanned 450 miles of the Platte River system from Schuyler, in eastern Nebraska, to Greeley, in north-central Colorado. Three days were spent in each locality. In order to obtain a better picture of the seasonal aspects, the localities, chosen in advance, were visited in an every-other-one sequence on the westward journey and the remaining ones were visited on the return eastward. The six easternmost localities were again visited in 1957.

In addition five other localities in southern and eastern Nebraska were visited. In the following discussions these first 15 localities will be considered in a generally east to west series. The abbreviations used in Figure 2 are indicated in parentheses.

Bellvue and Blair, Eastern Nebraska (Bvue and Blair).

Two pure *cyanea* were collected by Jerome H. Smith at Bellvue, on the Missouri River, on June 1, 1956. Three male buntings, two adults and one subadult were collected at Blair, Nebraska, June 4-6, 1957. One of these adults (C. U. No. 27610) shows the effects of introgression from *amoena*. It has traces of white on the underparts and of turquoise on the crown and rump (hybrid index = "3"). At Blair the buntings were found in fields among cottonwood saplings.

Schuyler, Nebraska (Sch).

Although favorable bunting habitat was present at this locality we neither observed nor collected one during the two visits.

Silver Creek, Nebraska (3 mi. SSW) (SiCr).

The single adult male is basically *cyanea* but shows the effects of *amoena* in the rump color. This was the only *Passerina* encountered during two visits in an area of seemingly excellent habitat.

Hastings and Crete, Nebraska (Hast and Crete).

One adult, and five subadult males were taken at these two southeastern Nebraska localities (3 mi. SSE Crete and 7 mi. S. Hastings). The adult and one subadult (from Hastings) were phenotypically pure *cyanea*. Three other subadults (2 from Crete, 1 from Hastings) were indexed as "1", showing traces of introgression from *amoena*. One subadult male from Hastings (C.U. No. 25497)

was nearly intermediate (hybrid index "5"), showing complete wing bars, indications of the breast band, and intermediate rump and crown color. Frequent reports of *amoena* at Hastings (previously cited) had indicated that hybrids might be found there, and this was verified. All buntings were taken near streams in heavy riparian cover.

Grand Island, Nebraska (7 mi. SSW) (GrIs).

A pure male (subadult) *cyanea* was obtained at this locality, which was visited during all three years for a total of nine days. Only four buntings were seen, two each in 1955 and 1956. All seemed to be pure *cyanea*.

Elm Creek, Nebraska (3 mi. SE) (Elm Cr).

Three males, two adult and one subadult, were taken in 1956. The adult showed traces of *amoena* influence in belly and rump color (C.U. No. 27386), while the others are apparently pure *cyanea*. In the meadows along the Platte five seemingly pure *cyanea* were seen in 1956, none in 1957.

Gothenburg, Nebraska (Goth).

No buntings were collected and none were seen in two visits (1956 and 1957). Seemingly good habitat exists in the riparian meadows and brushy fields near the river.

Sutherland, Nebraska (Suth and Halsey)

A single subadult male was taken one mile southeast of Sutherland, on July 6, 1956. Included with the specimen from this locality is an adult male taken June 13, 1955, two miles west of Halsey, Thomas Co., Nebraska (northeast of Sutherland). The subadult was intermediate in crown and rump color but was otherwise like *cyanea*. The adult was a pure *cyanea* ("0"). During visits to Sutherland in 1956 and 1957 no other buntings were found although numerous brushy fields and riparian meadows seemed to provide favorable habitat. Only one pair of buntings was seen near Halsey, in a clearing in the Nebraska National Forest (Bessey Division).

Big Springs, Nebraska (8 mi. W) (Big Sp).

Three males, two adults and one subadult, were taken in dense cover along the river in 1956. No others were seen. The adults are pure *cyanea* ("0") while the subadult has an intermediate rump color and a hybrid index of "1".

Crook, Colorado (5 mi. ESE) (Crook).

In early July, 1956, buntings were common at this locality and six adult and four subadult males were collected. One adult and one subadult are pure *cyanea* ("0") and one adult (C.U. No. 27400) is nearly pure *amoena* ("15") except for a partly clouded breast band. Of the others four are close to *cyanea* (ad. "1", "1"; subad. "1", "3"), two are close to *amoena* (ad. "13", "14") and one subadult is almost exactly intermediate in all characters ("7").

Large elms and other trees were present with brushy fields in the wide bottom lands along the river. All buntings were taken in the bottom lands and the males, of varying phenotypes, were found on adjacent territories. No differences in habitat preference associated with color type were found.

Fort Morgan, Colorado (8 mi. WNW) (FtMor).

Two male buntings, both showing evidence of hybridization, were collected

near Fort Morgan. One, an adult, has an index of "8", the other is a subadult and is close to *cyanea* ("2") but has traces of wing bars and a rump of intermediate color. No other buntings were noted in the meadows and woodland edges along the river.

Greeley, Colorado (7 Mi. SW) (Gree).

Four male hybrids (2 ad., 2 subad.) were taken here in 1956. One, a subadult (C.U. No. 27405), is mainly *cyanea* but shows *amoena* influence in the breast band and rump color. It has an index of "2", while the others are closer to *amoena*, the other subadult being indexed at "9", the adults at "13" and "14".

Buntings were common at this locality, especially in brushy fields near the river and both *amoena*-like and *cyanea*-like individuals were seen in addition to the ones collected. All males noted were singing and seemed to be on territories.

THE NIOBRARA RIVER TRANSECT

The Niobrara River flows west to east near the northern border of Nebraska. Three collecting localities were established in its drainage system.

Spencer, Nebraska (5 mi. SSE).

Three adult buntings were taken along the Niobrara River at the edges of oak woodland and fields. All are hybrids and close to *cyanea*, two with indexes of "1", the third has an index of "3".

Valentine, Nebraska (9 mi. ENE) (Val).

This area proved to be of special interest. The eight males collected included five adults and three subadults. Three of the adults are pure *cyanea* ("0") and one adult and two subadults are nearly pure *cyanea* ("1", "1", "2"). These have traces of wing bars and the one indexed at "2" also has turquoise in the rump. The other two specimens index at "9" (subad.) and "14" (ad.). The "9" specimen has a restricted breast band and wing bars and the crown color is intermediate. The "14" bird is close to *amoena* but the crown color is darker and the breast band smaller.

Most of the buntings were found along the weedy edges of hayfields near the river. In one 300 yard strip of such habitat six males were taken. A pure *cyanea* (C.U. No. 25502) was collected from a singing post on a bush only a few minutes after the nearly pure *amoena* ("14") (C.U. No. 25500), also singing, had been collected from the same bush. The other hybrid ("9") (C.U. No. 25505), which approaches *amoena* in color, was taken while singing in an area between the territories of two pure male *cyanea* (C.U. No. 25506 and 25507).

Chadron, Nebraska (Chad).

Six adults and four subadults were taken near Chadron. One was collected two miles northeast of Chadron, the other nine were taken along Little Bordeaux Creek, six miles southeast of Chadron. Most were found in brushy upland fields near open woodland.

One subadult (C.U. No. 25518) has an index of "6" and is intermediate in the extent of the breast band and in rump color. The crown is as in *amoena* but the wing bars are indicated only by faint traces, thus being more like *cyanea*. Of the other nine, three are pure *amoena*, four are nearly pure *amoena* but show slight traces of *cyanea* in breast band, rump and crown color. The remaining two are intermediate with indexes of "11" (ad.) and "9" (subad.).

SOUTH DAKOTA

The South Dakota localities do not form as complete a pattern, and fewer specimens are available. Eight localities are represented by specimens. Of these, four are represented by small samples, and four by single specimens. Each of the single specimens is included with the specimens from the major locality nearest that where it was taken.

Chamberlain, South Dakota (10 mi. S.) (Cham, Murdo).

Three adults and two subadults were taken in fields along the White River near its junction with the Missouri. One adult was taken west of Chamberlain, 10 mi. SSE Murdo, on the White River. All show evidence of hybridization. One adult (C.U. No. 25546) is nearly pure *cyanea* ("1") but has a lighter rump. The Murdo adult (C.U. No. 25551) is close to *cyanea* ("3") but has wing bar traces, some white on the belly and an intermediate rump. Another (C.U. No. 25547) is almost pure *amoena* ("14") but the crown is intermediate and the breast band is restricted. The other adult indexes at "10" and one of the subadults also at "10". The other subadult is exactly intermediate with an index of "6" (C.U. No. 25548).

Mobridge, South Dakota (9 mi. NNE) (Mobr).

Seven adult and three subadult males were collected on open, brushy hillsides and in meadows near the Missouri River.

One of the subadults (C.U. No. 25544) is a pure *cyanea* ("0") and one adult (C.U. No. 25535) is a pure *amoena* ("16"). The other eight specimens are close to *amoena* but all show evidence of *cyanea* in one or more characters.

Bridger Creek, South Dakota (Brid, Kad and Midl).

Four adults and one subadult were taken at this locality nine miles south-southeast of Howes, Meade County. In addition, one adult was taken six miles south of Kadoka, on the White River, and one subadult was taken on the Cheyenne River, in Haakon County, 45 miles north of Midland. At Bridger Creek a pure *cyanea* and a pure *amoena* were taken in a field, both having sung from the same tree within a few minutes of one another. The other three tend toward *amoena*, the subadult being nearly pure ("11" with the only evidence of *cyanea* influence being slightly restricted wing bars, while the two adults index at "10" and "12" and have indications of *cyanea* genes in the crown, rump, breast band and wing bars. Several other males, all seemingly *amoena*, were observed on song posts. The adult taken near Kadoka is a pure ("0") *cyanea*. The subadult from the Cheyenne River north of Midland has wing bars and crown color intermediate and breast band traces (index "4"), but otherwise is like *cyanea*.

Rapid City, South Dakota (Rap Cy and Spear).

Eight specimens (4 ad., 4 subad.) were taken in 1955 in the vicinity of Rapid City. In addition, two adults collected near Rapid City in 1948, and one adult taken in the Black Hills near Spearfish, South Dakota, were borrowed from the Pettingill collection.

Along Elk Creek, 11 miles north of Rapid City, buntings were quite common in 1955 and six specimens were collected in wooded, grassy areas along the creek. Of these one adult is pure *cyanea* ("0") and one subadult is pure *amoena* ("12"). The other four are hybrids. Two subadult hybrids were collected in brushy fields along Box Elder Creek, six and one-half miles north of Rapid City.

The two Rapid City area specimens in the Pettingill collection are adults, one is a pure *cyanea* from South Canyon and the other a nearly pure *amoena* ("15") from Dark Canyon. Both localities are at the eastern edge of the Black Hills. In 1955 apparently pure *amoena* were seen at the mouth of South Canyon but no *cyanea* were noted. The songs of both forms were heard in this area and seemed identical to all members of the party.

The Spearfish adult in the Pettingill collection is close to *amoena* ("14") but has restricted wing bars and a restricted breast band.

Crook County, Wyoming (Crook Co.)

One adult and two subadult buntings taken in June, 1949, in this eastern Wyoming county were borrowed from the Pettingill collection. Two are from 1 mi. SW Willson, one from 2½ mi. NSundance. The adult is pure *cyanea* and the subadults are hybrids with indexes of "4" and "9". These specimens, in an area where *amoena* would be expected to be the dominant form, indicate that the area of overlap probably extends well into Wyoming.

WEIGHTS AND MEASUREMENTS

The weights and measurements of the plains buntings, and of eastern (New York, Michigan) *cyanea* and western (California, Utah) *amoena* samples, indicate the following:

(1) Mensural differences exist between *cyanea* and *amoena* from eastern and western North America.

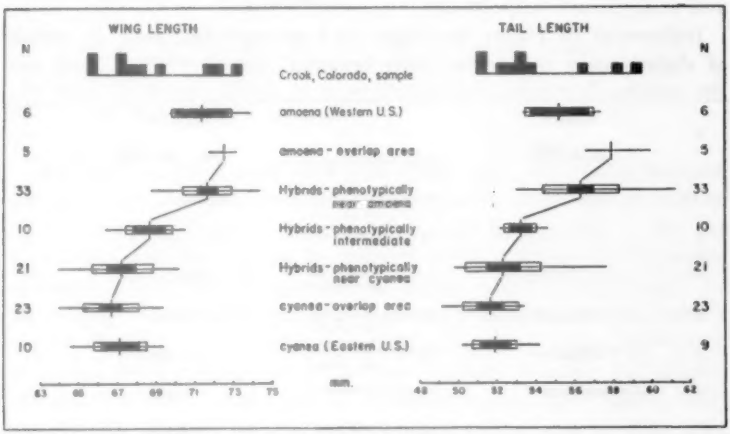

FIGURE 3. Statistical analysis of wing length and tail length of *P. cyanea*, *P. amoena* and hybrids. Histogram of the sample from one locality shown at the top with each square representing a specimen. Horizontal lines represent the range; rectangles indicate one standard deviation from the mean and the solid black marks twice the standard error of the mean. The means are indicated by vertical lines.

(2) Similar differences exist between pure ("0") *cyanea* and pure ("16" adults and "12" subadults) *amoena* from the plains.

(3) Hybrids are intermediate between the parental forms in weights and measurements.

(4) There is a correlation between the color pattern (i.e., the hybrid index) and the measurements and weights of the hybrids.

These points are illustrated in Figures 3-5 and are discussed below.

Differences Between cyanea and amoena. It is apparent from Figure 4 that *cyanea* is somewhat smaller than *amoena*. While weights were unavailable for far eastern or western buntings, the difference between the two forms in the plains, and the greater wing and tail lengths of *amoena* (see Amadon, 1943, for correlation between wing length and body size) indicate that *amoena* is the larger form. Differences exist in tarsal length and bill length (from nostril), in addition to the wing length (chord) and tail length differences shown in Figure 3. The bill of *cyanea* is slightly larger than that of *amoena* (mean = 7.63 mm. in *cyanea*, 7.27 mm. in *amoena*, for 10 and 8 males respectively). The eastern *cyanea* also has a slightly longer tarsus (mean = 17.39 mm.) than has *amoena* (mean = 16.77 mm., with same N as for bill length). (See Figures 4 and 5 for bill length and tarsal length respectively.)

Differences in Plains Buntings. An average difference in weight of slightly over one gram exists between "pure" ("0") *cyanea* and

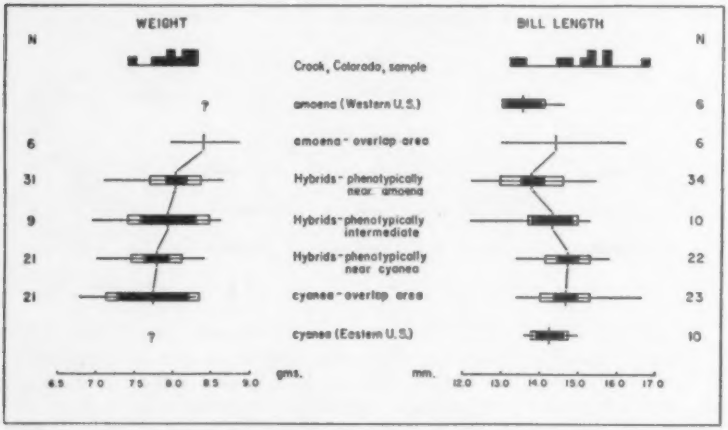

FIGURE 4. Statistical analysis of weight and bill length of *P. cyanea*, *P. amoena* and hybrids. See Figure 3 for explanation.

"pure" ("16" adults, "12" subadults) *amoena* taken in the plains (Fig. 4). The wing lengths, and tail lengths of the two forms, as shown in Figure 3, differ by more than do the far eastern *cyanea* and western *amoena*. However, the plains buntings approach each other closely in bill length (mean = 7.84 mm. in 23 *cyanea*, mean = 7.70 mm. in 6 *amoena*), and also in tarsal length (mean = 17.27 mm. in 23 *cyanea*, mean = 16.87 mm. in 6 *amoena*).

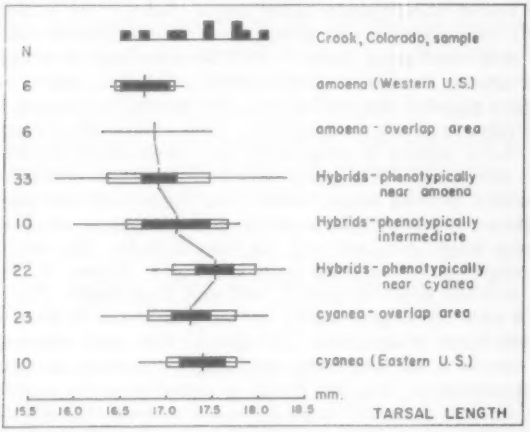

FIGURE 5. Statistical analysis of tarsal length of *P. cyanea*, *P. amoena* and hybrids. See Figure 3 for explanation.

The significance of these data is twofold. The differences between eastern *cyanea* and western *amoena* have not been lost due to swamping following widespread hybridization and backcrossing. On the other hand, selection against hybridization has not resulted in greatly increased divergence in bill length, tarsal length, wing length or tail length. Some such divergence is to be expected if selection is against the hybrids and isolating mechanisms are being reinforced, for under these conditions competition becomes effective in favoring divergence toward adaptation for different niches (see Sibley, 1957, pp. 169-170, 182-183, for discussion on this point, and Vaurie, 1951, for the fine example in *Sitta neumayer* and *S. tephronota*). In the buntings the time which has elapsed since the breakdown of isolation has apparently been too short to have resulted, as yet, in either reinforcement or swamping.

Intermediacy of Hybrids. This point is shown in Figures 3-5. The

three centrally located samples, including all hybrids and backcross individuals, are intermediate between the "pures" in all weights and measurements. This intermediacy is noteworthy (although to be expected), since the hybrids were initially identified as such on the basis of color pattern only.

Correlation Between the Hybrid Index and Weights and Measurements. The three groups of specimens between the "pure" *cyanea* and "pure" *amoena* plains samples in Figures 3–5 are hybrids grouped according to their hybrid index number. Those hybrids phenotypically nearer *cyanea* (index = 1–5 in adults and 1–3 in subadults) were placed in one group; those intermediate in color characters were placed in a second group (index = 6–10 in adults, and 4–8 in subadults; and those nearer *amoena* in color characters (index = 11–15 in adults, and 9–11 in subadults) were placed in the third group. The correlations between wing length and hybrid index is shown in Figure 3. Those individuals indexed closer to *amoena* are nearer *amoena* in wing length also, when compared with the intermediates or with *cyanea*. The phenotypically intermediate individuals are likewise intermediate in wing length between the "pures" of both parental forms from the plains. Those individuals nearer *cyanea* in hybrid index are closer to *cyanea* in wing length, compared with the other hybrids. The same situation is shown by comparing hybrid index with tail length (Figure 3), with weights (Figure 4), with bill length (Figure 4), and with tarsal length (Figure 5). The correlation is clear for weights despite the small difference in mean weights between the two forms in the plains (1.28 gms.). The small differences between *cyanea* and *amoena* in bill length and tarsal length complicate the picture slightly for these measurements. The bill length of plains *cyanea* is greater than that expected on the basis of the bill length of western *amoena*, although the difference is not large. However, the hybrids indexed near *cyanea* are longer billed than those indexed near *amoena*, and the gradient in the three hybrid groups clearly shows the correlation between hybrid index and bill length. In tarsal length, the plains *cyanea* have shorter tarsi than do eastern *cyanea*, although the difference is not large. The gradient exists in the three groups of hybrids for this character also, showing the correlation between tarsal length and hybrid index.

Variation in Linear Measurements and Weights in Locality Samples. Histograms depicting the weights and measurements of the male buntings from Crook, Colorado, (see discussion under that locality concerning the hybrid indexes of the specimens) are included in Figures 3–5. This sample is typical of the larger plains samples in that great variation is shown in all five mensural characters. The variation in wing length, tail length, tarsal length, and bill length approaches that of *all* the phenotypically pure *amoena* and *cyanea* specimens taken in the plains. While the variation in weight is not so great, it is nevertheless quite considerable. As we have shown the linear measurements and weights are closely correlated with color pattern (hybrid index). Statistical treatment of the samples by locality was not carried out because the small size of the samples, and the possibility of non-random mating, cast doubt on the validity of such a treatment. In regard to the latter point, if non-random mating were occurring, samples would represent a non-panmictic population. Hence, statistical treatment of the small samples available was not attempted.

DISCUSSION

The bunting situation in the plains is the result of a recent secondary contact between the two formerly isolated *amoena* and *cyanea* populations. The differences exhibited by the forms could only have arisen under different selective forces acting on allopatric populations. When the barrier between them was broken the forms extended their ranges and came into contact. This contact has resulted in hybridization as described. The changes which have affected bird populations in the plains include the planting of trees and shrubs in shelterbelts, around villages and buildings, and along the rivers. The control of prairie fires, which formerly burned extensive areas periodically, and the control of the rivers, which formerly flooded at intervals washing away vegetation along the banks, have resulted in more continuous riparian vegetation. It is also suggested that removal of the Indians and the buffalo from the plains played a role in increasing the habitats available for woodland birds in that region (see Sauer, 1950, for comments on these effects). Removal of the Indians aided in eliminating the prairie fires they occasionally caused. Periodic trampling of vegetation along rivers, rendering such areas unsuitable for habitation by birds, was an effect of the former huge herds of buffalo.

Natural changes which have increased suitable habitat for buntings and other woodland species of birds include the ameliorating climatic conditions in the plains and the consequent movement of trees and shrubs into the valleys of the plains.

An obvious effect of these changes is the increase in the contact area between the two buntings through the development of suitable habitat for breeding. Furthermore, shelterbelts and tree plantings provide suitable resting places for migratory birds where none previously existed. This has probably aided in the colonization of the plains by the buntings. The discontinuous distribution of the buntings in the plains suggests that stray birds may be aided in colonizing suitable areas by this means. The suggestion of Wells (1958), concerning rapid population expansion in *cyanea* following the last glaciation and opening up of the eastern woodlands, should also be taken into account when considering colonization of the plains by the buntings. Stray birds forced westward by population pressure could exploit favorable areas by such "stepping-stones" as the shelterbelts. The present discontinuous distribution of the buntings in the plains may be influencing the hybridization by limiting gene flow between disjunct populations.

In situations of this nature, the problem of proper taxonomic recognition of the hybridizing forms inevitably arises. As one of us has pointed out (Sibley, 1957), the crucial point is the effect of selection on the apparently fertile hybrids being produced. If selection is operating against the hybrids, reinforcement of isolating mechanisms should occur, resulting in further divergence of the two interbreeding forms. If selection is not operating against the hybrids, then sufficient gene exchange should result in the swamping out of the differences between the two forms as selection fashions a new adaptive combination from the variable gene pool available.

Unfortunately, the determination of the direction of selection acting on the hybrids is difficult in hybrid situations of relatively recent occurrence.

Looking at the situation from one point of view, the number of hybrids taken (66) compared to the number of "pure" individuals of both forms (29) indicates regular gene exchange of sufficient frequency to suggest that all the gene combinations of each form are available to the gene pool of the other. The continuation of such a contact will prevent speciation. On this basis, the forms can be considered conspecific.

Another point of view would stress the fact that "pures" of each form are present with the hybrids at some localities. The great amount of overlap (400+ miles) in which "pures" of both forms, as well as hybrids, are found, would be stressed also. Advocates of this viewpoint would consider the two forms separate species.

The problem in this case can be reduced to a single question, namely: is random mating actually occurring, the large area of overlap being due to the discontinuous distribution of the buntings and their habitat, or is this overlap due to the occurrence of nonrandom mating in which "pure" individuals of one form are tending to mate with individuals of the same form, rather than with hybrids or individuals of the other form? Our data cannot answer this question conclusively. Further study of the populations in the field should give a better basis for a taxonomic decision.

ACKNOWLEDGMENTS

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SUMMARY

The Indigo Bunting (*Passerina cyanea*) and Lazuli Bunting (*P. amoena*) have formed a secondary contact in the plains as a result of climatic changes and man's activities, which have provided suitable habitat in a formerly unsuitable area. Over a broad area of contact and overlap specimens show that hybridization and backcrossing are occurring, and that both parental forms are present with the hybrids at some localities. The hybrid index technique indicates that 66 out of 95 specimens from 21 localities are hybrids or the result of backcrossing. The hybrids and the situation at each locality are discussed.

Measurements and weights of the specimens show that clear size differences exist between the two forms, that the hybrids are intermediate between the parental forms, and that color pattern is correlated with weights and measurements in the hybrids. No evidence is found for increased divergence of the two forms due to reinforcement of isolating mechanisms and/or the effects of competition. Neither is there clear evidence which indicates that swamping of the existing differences is in progress.

The effects of nature and man in causing the contact between the previously isolated forms are discussed. We postpone a taxonomic decision on the status of the two buntings pending the accumulation of more information, particularly in regard to pairing, mate-selection and habitat preference of the two forms in the area of hybridization and overlap. Data presented in this paper provide bases for arguing for conspecificity, as well as for maintaining the two forms as separate species.

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COLOR-DYED SHOREBIRDS

As part of a shorebird population study on the Florida Gulf coast, a large number of shorebirds were trapped, banded and color-dyed in the spring of 1959. Birds caught in May were dyed a vivid golden color; birds trapped in June were dyed scarlet, which apparently faded to pinkish within two weeks. Other colors will be used in the fall, 1959. Those observing colored shorebirds should communicate with Horace Loftin, Dept. of Biological Sciences, Florida State University, Tallahassee, Florida.

Ed. Note: Those employing a dyeing technique for marking birds should be careful to refrain from obscuring field-marks and should avoid colors that resemble or may fade or change into hues borne by other species of the group.

PERCY FITZPATRICK INSTITUTE OF AFRICAN ORNITHOLOGY

Applications are invited for the post of Director of the newly-founded Institute at the University of Cape Town. The Institute is an independent organization, but the post carries academic status. Applicants should have an M.Sc. or its equivalent, preferably in zoology, and have experience in organized research. Applications giving age, marital status, qualifications, and experience, and accompanied by two recent testimonials, must reach the Chairman of the Board of Control before 1st February, 1960. Particulars regarding duties, salary, and other matters may be obtained from: C. K. Niven, Chairman, Board of Control, Amanzi, Uitenhage, Cape Province, South Africa.

MORTALITY OF THE GREAT BLUE HERON AS SHOWN BY BANDING RECOVERIES

BY D. F. OWEN

This paper is a preliminary attempt to present the mortality rate of the Great Blue Heron, *Ardea herodias*, based upon banding recoveries; more recoveries would doubtless give a better picture of this mortality, and hence further large-scale banding of the nestlings of this species is desirable.

The longevity of the Great Blue Heron is here calculated by using recoveries of dead birds which were banded as nestlings in the United States and Canada from the earliest year of banding, 1916, up to and including the year 1945. Most birds banded during and before 1945 should now be dead, but birds banded since then are omitted as more than a negligible proportion of them might still be alive. The 349 recoveries used in the following analysis were obtained in the period 1916–1958.

For the purposes of this paper, the term "older birds" refers to all birds alive after the June 30 following the year of hatching. The word "adult" is avoided because of uncertainty as to the age when the Great Blue Heron achieves reproductive condition.

Mortality Rate

In Table 1, deaths are grouped by age in years, each year being reckoned from July 1 to June 30. A few nestlings which were reported before they could have left the nest successfully have been omitted, as also have a few birds reported with insufficient details of recovery. The method of analysis follows that used for the Gray or Common Heron *Ardea cinerea* in Britain (Lack, 1949). Table 1 shows that

TABLE 1

The Age at Death of Great Blue Herons Banded as Nestlings 1916–1945

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Number found dead	248	41	14	13	11	5	6	3	0	1	1	0	0	1	2	1	0	1	0	0	1

of the recovered Great Blue Herons, 71 percent died within a year of leaving the nest, and that the average annual mortality in later years was 29 percent. The expectation of life of the Great Blue Heron after leaving the nest is 1.5 years, but once a bird has reached the beginning of its second year the expectation of further life is 2.9 years.

The average annual mortality may be calculated by $\frac{D_2 + D_3 + D_4 \ldots\ldots}{D_2 + 2D_3 + 3D_4 \ldots\ldots}$ where D_2, D_3, $D_4 \ldots\ldots D_n$ = the number of birds found dead in the 2nd, 3rd, 4th . . . . . nth years, respectively. The expectation of further life (e) may be calculated by $e = \frac{2 - m}{2m}$ where m = the annual mortality.

Greater mortality in the first year of life than in subsequent years has been shown to occur in many species of birds (Lack, 1954), and in the Great Blue Heron, as in the Gray Heron, this mortality is very high. In Table 2 the mortality of the Great Blue Heron in North America and the Gray Heron in Britain is compared, the mortality of birds during the first year of life after leaving the nest being 71 per-

TABLE 2

COMPARISON OF THE MORTALITY OF GREAT BLUE HERON AND GRAY HERON

	Great Blue Heron (North America)	Gray Heron* (Britain)
Number of recoveries used	349	195
Mortality in first year (percent)	71	69
Average annual mortality after first year (percent)	29	31
Expectation of life after leaving nest (years)	1.5	1.5
Expectation of further life at beginning of second year (years)	2.9	2.7

* Figures for Gray Heron from Lack (1949). Lack (1949) gives the expectation of further life at the beginning of the second year as 2.8 years, but this is corrected to 2.7 years in Lack (1954: 92).

cent and 69 percent, respectively, and the average annual mortality of older birds being 29 percent and 31 percent, respectively. The Gray Heron is similar in morphology and habits to the Great Blue Heron and these two birds are considered by some to be conspecific. These two sets of figures, calculated in the same way, perhaps suggest that the banding recoveries give a good estimate of the mortality rate in these two species, especially when one considers the comparatively small size of the British Isles and the different types of bands used.

In Scandinavia, banding recoveries of the Gray Heron, analyzed somewhat differently, indicate that 67 percent of the birds leaving the nest die in their first year, and that the average expectation of further life is 3.1 years (Olsson, 1958). In Belgium, recoveries indicate that 78 percent die in their first year (Verheyen and Le Grelle, 1952), while in France the figure is about 73 percent (Bourlière, 1947).

Table 3 shows the monthly mortality of Great Blue Herons. For this analysis all available banding recoveries have been used. During the first year after leaving the nest the greatest mortality occurred in the period August–December; thereafter there was a steady decrease in the number of birds dying in each month. This high mortality is presumably caused by inexperience. Similarly, in the Gray Heron there is a high mortality during the first year, which appears to decrease from January onwards (Lack, 1949). Recoveries of Black-

TABLE 3

SEASONAL VARIATION IN MORTALITY OF GREAT BLUE HERONS

Month	Mortality in first year after leaving the nest		Mortality of older birds
	Age in months	Number dying	Number dying (not separated by age)
July	1	22	12
August	2	70	8
September	3	60	10
October	4	49	14
November	5	52	13
December	6	47	17
January	7	28	12
February	8	15	7
March	9	9	7
April	10	5	15
May	11	4	13
June	12	4	8

crowned Night Herons *Nycticorax nycticorax* banded as nestlings in North America likewise show a high mortality in the period August–December and a steady decrease in subsequent months (Hickey, 1952). Table 3 also shows the number of older birds dying during each month. There are fewer figures available for older birds than for first-year birds, but there seems to be little monthly variation in the death-rate, except perhaps that in April and May the mortality of older birds exceeds that of first-year birds. Similar results were obtained by Hickey (1952) for the Black-crowned Night Heron. It must be mentioned that the month when a Great Blue Heron is reported dead is not necessarily always the month during which the

bird died. Great Blue Herons are large birds and a carcass might remain in a recognizable condition for a long time before being reported. However, the figures given in Table 3 can be taken as an approximation.

CAUSES OF DEATH

Of 139 recoveries of older Great Blue Herons, 24 percent were reported as shot, and of 392 first-year birds, 28 percent were reported as shot; this difference is not statistically significant. Similarly, in the Black-crowned Night Heron the difference between the number of older and first-year birds reported shot is not significant (Hickey, 1952). Lack (1949) states that "many" of the Gray Herons recovered were shot, and he considered it possible that birds were more frequently shot in their first year of life than later, but he did not analyze his figures. In Scandinavia, rather more first-year than older birds were reported shot (Olsson, 1958), but the difference is not statistically significant.

The remaining Great Blue Herons were reported as "found dead" or dead from a variety of causes. Apart from shot birds, the reliability of a report of the cause of death of a bird is in most cases questionable, hence the figures have not been analyzed further.

DISCUSSION OF MORTALITY RATE IN GREAT BLUE HERON AND GRAY HERON

Hickey (1952) has drawn attention to the numerous possible sources of error involved in an analysis of banding recoveries. Errors are likely to be considerable in any analysis of recoveries of birds breeding and migrating over a large area, such as North America, where the chances of recovery might vary markedly from place to place. The Great Blue Heron is migratory over much of its range, and any difference in the wintering area or migration route of first-year and older birds might affect the chances of recovery of these two classes. There is some evidence that such differences exist. Thus, of the 349 recoveries used in Table 1, 45 were from Mexico, Central America and the West Indies, and the chances of a banded bird being reported from these areas, with its large population of non-English speaking people, would presumably be less than in an area such as the eastern United States. Of these 45 recoveries, 24 were birds in their first year and 21 were older. These figures may be compared with 266 recoveries from the eastern United States, comprising 200 first-year and 66 older birds. Thus, of the birds recovered in the area comprising Central America, Mexico and the West Indies, proportionately more were older (47 percent) than from the eastern United States

(25 percent). The difference between the proportion of older to first-year birds in the two areas is statistically significant ($P = > 0.01$). Many of the first-year birds have, of course, already died before or on migration to their winter quarters; this would explain the smaller proportion of first-year birds recovered in Mexico, Central America and the West Indies, as compared with North America. If then it is assumed that the chances of recovery from these two areas are not equal, the fact that proportionately more older birds die south of the United States means that a smaller proportion of the total number of banded older birds than banded first-year birds is reported. However, recoveries of Great Blue Herons in Central America, Mexico and the West Indies comprise only 13 percent of the total recoveries used in Table 1; hence this potential source of error cannot be large. All that can be said at present is that the first-year mortality shown in Table 1 should be slightly lower, and the mortality of older birds should be slightly higher. Possibly, if there were more figures available, more local variations in the proportion of older to first-year birds dying might be detected.

Another possible source of error is that older birds tend to lose their bands or that after a time the bands become illegible. This would reduce the number of reports of the older birds. Many ornithologists seem to think that loss or illegibility of the inscription occurs more frequently among sea-birds than birds that feed mainly in fresh-water. In the Shag, *Phalacrocorax aristotelis*, the calculated average annual mortality from dead recoveries was 44 percent, whereas using Jackson's "negative method" on live recaptures it was calculated at 14 percent, a significant difference (Coulson and White, 1957). In the Gray Heron, the average annual loss of weight of the bands was only about one percent of the total weight, whereas in the Herring Gull, *Larus argentatus*, there was an average annual loss of weight of about five percent due to abrasion and corrosion (Olsson, 1958).

The additional fact that the average annual mortality of older birds calculated from dead recoveries of Great Blue Herons and Gray Herons is so similar, despite the different types of bands used, suggests that loss or illegibility of the bands is not an important source of error.

It would be possible to check the validity of the figures given in Table 1 for average annual mortality of older birds, if we knew precisely the reproductive rate of the Great Blue Heron. Lack (1949) was unable to explain how with such a high mortality rate for older birds and an apparently low average number of young per nest (2.14 at one colony in England), the Gray Heron population was able to main-

tain itself. But since 1949 I have found that this low reproductive rate is not typical of all years. The number of young leaving the nest varies markedly from year to year and from colony to colony, depending upon the availability of food to the parent birds (Owen, *in press*). Thus, at one colony in the south of England nearly half the young died of starvation in one year, while in the next hardly any died. Similar differences were found at other colonies and in other years. In the Gray Heron the clutch-size did not vary significantly over six years and the variable average number of young leaving the nest could be attributed to mortality in the nest caused by food shortage. Such differences as these would have to be taken into account when comparing average annual mortality of older birds with the reproductive rate. No comparable figures are available for the Great Blue Heron.

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SUMMARY

1. Based on the recoveries of birds banded as nestlings, the mortality of the Great Blue Heron in the first year of its life was calculated at 71 percent, and the average annual mortality in subsequent years at 29 percent. These figures are similar to those calculated for the Gray Heron in Britain.

2. During the first year of life there is a high death-rate in the period August–December, which then decreases steadily.

3. Possible sources of error in calculating this mortality rate are discussed. Evidently a greater proportion of older birds than first-year birds die in Mexico, Central America and the West Indies than in the eastern United States, presumably because many of the birds banded as nestlings have died before reaching winter quarters.

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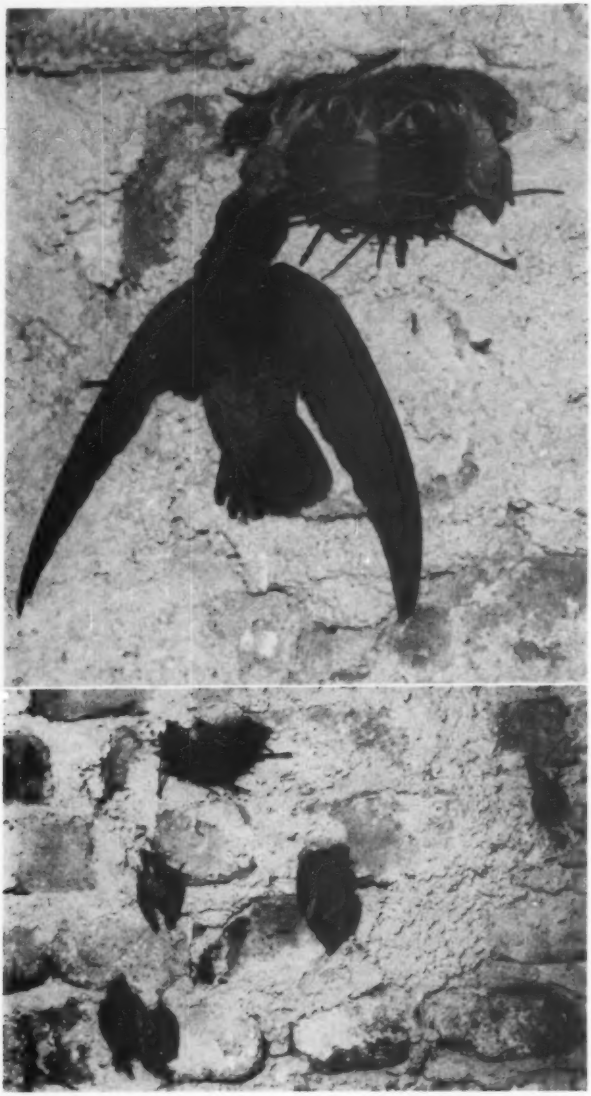
NEW PUBLICATION

A new publication series, *Occasional Papers of the C. C. Adams Center for Ecological Studies,* will begin to appear in late 1959 or early 1960. Persons or organizations interested in being placed on the mailing list should communicate with: Director, C. C. Adams Center for Ecological Studies, Western Michigan University, Kalamazoo, Michigan.



(Above) Chaetura andrei meridionalis feeding nestlings. Niteroi, Rio de Janeiro, Brazil. November 29, 1953. (Leicaflash, 1/100 sec., obj. 13.5 cm., distance 3 m.) Photo by H. Sick.

(Below) Nest of *Chaetura andrei meridionalis*, with eight living young on wall of attic. Niteroi, Rio de Janeiro, Brazil. December 15, 1955. Photo by H. Sick.

NOTES ON THE BIOLOGY OF TWO BRAZILIAN SWIFTS, *CHAETURA ANDREI* AND *CHAETURA CINEREIVENTRIS*

BY HELMUT SICK

Recent papers on the North American Chimney Swift, *Chaetura pelagica,* make it of interest to compare some phases of behavior of two of its relatives in Brazil that have also taken to nesting in chimneys and inside buildings.

The Ashy-tailed or André's Swift, *Chaetura andrei,* has an extensive South American range; the nominate race is known only from Venezuela, but the larger *C. a. meridionalis* breeds south of the Equator in eastern and central Brazil, northern Argentina and Paraguay, with records, presumably of migrants, in northern Colombia and Panama (Peters, 1940: 240). In size and sooty color of head and back, *C. andrei* resembles the Chimney Swift, but has the throat, rump, upper and under tail-coverts and most of the very short tail a pale ash gray, while the breast and abdomen are dark gray. The Gray-rumped Swift, *C. cinereiventris,* ranges (with many subspecies) in tropical lowlands from Nicaragua to the state of Rio de Janeiro, Brazil (Peters, 1940: 238). The race I have studied, the southernmost, *C. c. cinereiventris,* is about an inch smaller than *C. andrei meridionalis,* has glossy black upperparts (except for sooty gray rump and upper tail-coverts), and mainly dark sooty gray underparts. These species are sympatric in parts of Brazil, including Rio de Janeiro. The breeding season of both in southeastern Brazil usually begins in September or October and ends in February or March. Elsewhere I have described nests of these species, as well as certain aspects of their biology (Sick, 1948, 1950, 1955, 1958).

1. *Re-use of nests and carrying of nesting material.*

Late in 1953 at Niteroi, state of Rio de Janeiro, I saw my first attic nest of *C. andrei,* under the roof of a house. Previously I had found nests only in the hollow of *Mauritia* palms (Goias and Mato Grosso) or in chimneys (Rio de Janeiro). A pair returned annually to the same attic site. The 1953 nest fell in 1954 and was rebuilt on the same spot. It was re-used in 1955 and 1956. In 1957 it fell again and was rebuilt on the same spot. It was also used in 1958, but dropped down during brooding of young. The adults rebuilt the nest on the same spot, and each year successfully reared young.

The Gray-rumped Swift, *C. cinereiventris,* seems to act similarly. A pair nesting in a chimney in Rio de Janeiro in 1958–59 lost in one season two nests with young several days old, so that no young were

reared that year. Nevertheless the following year a pair returned to the same chimney, although on at least three previous occasions (Dec. 1953, Nov. 1958 and Jan. 1959) nests with eggs or young had been lost (4, 3 and 2 per nest). One gains the impression that nests in chimneys are apt to drop off because soot keeps the nesting material from adhering firmly to the wall. This disadvantage does not prevent the birds from re-using the location once it has been chosen. Similar reports have been published of the Chimney Swift (Dexter, 1952).

In November 1953 I observed a *C. cinereiventris* during the period of nest-building flying with a small twig held crosswise in its bill.

2. *Laying of eggs in one nest by more than one female.*

On December 15, 1955 I was called to Niteroi by the owner of the house in the attic of which *C. andrei* was nesting again. I was told that there were so many young that there was not room for all in the nest. I found this: two young were in the nest, six more young were hanging from the wall about a foot from the nest, and one dead young was lying on the floor. The total was nine young (Plate 21, *Below*). The difference in age of some of the young was marked. Four of the young hanging close together had quite a few well developed feathers, and may have been twelve days old. One young hanging alone below the nest may have been one day younger, the two in the nest were about two days younger. The young hanging farthest away from the nest was still quite small, almost quite naked and blind, possibly seven days old. The dead young was still smaller; it may have fallen two days before and, if so, may have hatched on the same day as the youngest living bird. (Estimates of the age of the young are based on the pictures in Fischer's 1958 paper on the Chimney Swift.) There were at any rate three age groups: 4 large, 3 medium and 2 small young.

When I arrived at the spot, in addition to the young, there was one adult hanging near the nest. The adult soon flew off and no other adult appeared as long as I remained. I left the attic before dark and returned after fifty minutes. Seven of the young had regained the nest. The only one missing was the youngest, which was hanging on the same spot as before. Near the nest three adults were hanging; six other adults were hanging further away on the same wall as the nest.

This curious case can only be interpreted by assuming that two or, more probably, three females laid their eggs in the same nest. The normal clutch at this site of *C. andrei* seems to be three or four. In Mato Grosso I twice observed five eggs (Sick, 1948; 517). As previ-

ously reported (Sick, 1958), a breeding pair of this swift is frequently joined by one to three other individuals. An even greater number has occasionally been noted. With *C. pelagica* only one or two additional birds at a nest have been reported (Dexter, 1952). Dexter gives for the Chimney Swift many details about the age, sex, mating combinations and assistance in brooding and feeding of these extra birds. However, laying of eggs in one nest by more than one female of the Chimney Swift has apparently not yet been reported.

While I was unable to revisit the Niteroi nest during the 1955 season, I was informed that the young developed well and flew off. In December, as in October and November, usually seven adults spent the night against the wall where the nest was located. At this site the first *C. andrei* arrived on September 5, 1955. The breeding season ended in the middle of April 1956 when the last of the swifts, a group of nine, disappeared. This period corresponds with the Southern Hemisphere spring (September–October) and summer (November–April), which is the usual breeding season of these swifts in southeastern Brazil.

3. *Downward head position in gaping and sleeping of young.*

According to Fischer (1958: 99), young of the Chimney Swift beg with heads pointed up, and to feed them the adult, after settling on the nest, bends down its head, which is encompassed by the upturned head of the nestling. The young of *C. andrei* have a tendency to beg with the head hanging below the nest. I first noticed this while photographing the attic nest at Niteroi, which permitted observations not possible in chimney and tree nests.

When I first visited the Niteroi nest on November 29, 1953, the young may have been nine days old. They were good-sized but still blind, with backs and wings fairly well covered with pin-feathers. The sleeping young had their heads hanging down over the edge of the nest. In this strange position the little swifts were fed during the one feeding that occurred during the three hour period of observation. The adult fastened onto the brick wall below the nest, while the three young begged downward over the edge of the nest (Plate 21, *Above*). After being fed in this position, the young rested their heads on the edge of the nest.

I observed downward begging of *C. andrei* in the same manner two years later at the same location—the only check I could make. I saw no actual feeding, for the parents were disturbed by my presence. I received additional observations about downward begging from Mrs. Abendroth of Teresópolis, Rio de Janeiro. She observed it several

times in young *C. andrei* still blind, which were reared by her. Recently she observed the same with a young bird that could already fly. The bird closed its eyes when it begged.

While this manner of begging does not seem unusual with *C. andrei*, sleeping with head downward appears to be exceptional in birds. I had observed this once previously with young manakins *(Pipra erythrocephala)*.

I made the following notation about the manakin: "Alto Xingú, Mato Grosso, December 3, 1947, 12:43 p.m.—the bigger one of the young, 13 days old, drops its head over the edge of the nest in his sleep. The head is dangling vertically as if the bird were dead. 12:44 p.m.—feeding (normal, from above!). 12:45 p.m.—both young resume a resting position with eyes closed. The bigger one has put its bill on the fork of the branch that supports the nest. After half a minute his head slips off. It moves its head up holding it free in a horizontal direction. Shortly after this the head begins to tremble and soon the head falls down and hangs again over the edge of the nest. This position is maintained for more than one minute. Then the young raises its head. This action is repeated twice. One is reminded of a man falling asleep sitting-up, unable to find a rest for his head. Finally the young turns in the nest and crawls partly over the sibling, younger by one day, that almost fills the nest completely and goes on sleeping with its head resting securely."

Sleeping with *outstretched* neck is not uncommon among newly hatched birds. If the nest is quite small (swifts, manakins), or if the young are relatively large, the curious drooping position may occur. It will not claim attention unless there is no support for the head. Generally it is the gullet that rests on the support; in some cases it is the side of the head, as for example with a Tropical Screech-Owl, *Otus choliba*, raised by me. This was also observed by Michaelis of a European Eagle Owl, *Bubo bubo*—"sleeping in baby position" (1952: 40). The same was noted by Goethe (1955: 409) in a one day old Herring Gull, *Larus argentatus*, and by Seitz in a Eurasian Curlew, *Numenius arquata* (1949: 37). Seitz writes that the young curlews try from the start to put their heads on their backs, although not succeeding during their first few days.

4. *Releaser mechanism in feeding.*

At the Niteroi nest it could clearly be observed that the young started to beg upon hearing the wing noises of an approaching adult. These young were seven to twelve days old. Therefore, begging was stimulated by hearing. When rearing a clutch of *C. andrei* in a basket, Mrs. Abendroth noted some years ago that even a draft would start begging. Barton (1958) relates the same about the Chimney

Swift. Fischer states in his thorough paper that the reactions of the young of *Chaetura pelagica* change with age. Always, however, it was the sound of approaching wings which brought forth the strongest begging.

5. *Sitting on the nest at night by both parents.*

We have no observations on this with *C. andrei*, but we do have one with the related *C. cinereiventris*, which I was able to observe at a chimney nest in Rio de Janeiro in 1953. The parents were sitting close together on the nest during the night so that only the tails and wing-tips, protruding over the nest, could be seen from below. At the time of my observation the nest of *cinereiventris* contained four eggs. This is similar to Fischer's (1958: 54, 113) description of the behavior of Chimney Swifts.

6. *Snapping of wings and "thundering."*

With *C. andrei* one may not infrequently hear a snapping of wings at the nest and at the collective winter roost (Sick, 1958). It is a single snap, sounding like "flap", which is repeated after short intervals. How do the swifts produce this noise? I noted the following at the nest in the attic at Niteroi: The bird, which was hanging from the wall, moved its wings back until their coverts touched, making a rustling noise. Then it moved its wings violently back to their normal resting position causing a loud snapping noise. Before seeing this I had assumed that the opened wings were hitting the wall (Sick, 1950).

C. andrei make this snapping noise when they are disturbed; for example, when a man approaches their nest. First they snap as they hang from the wall near the nest. If the disturbance continues, they slowly crawl sideways and upward in the direction of the flight hole and there clap again. Finally they fly off. The clapping seems to have the function of a threat.

The Chimney Swift acts in a similar manner. Fischer (1958: 91) has an excellent photograph with the caption "to scold an intruder, the chimney swift snaps its wings together while in flight. After slowly arching its back and raising its wings, as shown here, the bird springs backward into flight and produces several loud snaps before coming to rest." From this it appears that *C. pelagica* snaps in flight.

Eigsti (1947) reports that Chimney Swift when disturbed at the nest may produce noise in a different manner. One bird, observed in Hastings, Nebraska, after a light drove it from its nest, started to drum the upper side of its wings against the opposite wall of the chimney.

Here, too, it was the upper side of the wings that produced the clapping noise; in this instance, according to Eigsti, against the wall—an occurrence possibly caused by the narrowness of the chimney.

This noise, which Eigsti calls "fluttering" or "drumming", reminds one of the other noise of uncertain origin occasionally heard when swifts fly in and out of chimneys or hollow trees. With *C. andrei* one hears a rustling noise if they are in narrow chimneys. If they are in wider chimneys the noise is deeper, more like a "thundering," or rumbling. From my observations, the "thundering" of *C. andrei* is not produced by beating against a wall, but by clapping their wings without touching the inside of the chimney, while the birds are sliding down or fluttering upward. I have not heard "thundering" inside attics. Moore (1946) quite rightly draws attention to the acoustic factor. The "thundering" can only be produced under certain physical conditions. It is for this reason that many observers have never heard swifts "thundering."

SUMMARY

Various aspects of nesting behavior of two Brazilian swifts, *Chaetura andrei meridionalis* and *Chaetura cinereiventris cinereiventris,* are described and compared with the behavior of the North American Chimney Swift, *Chaetura pelagica.* Both Brazilian swifts now often nest in chimneys and *C. andrei* also in attics.

Re-use of nests and rebuilding at the same sites for many years is frequent in *C. andrei* and *C. cinereiventris.*

Transportation of nest material in the bill was observed in *C. cinereiventris.*

At one nest of *C. andrei* in an attic eight living and one dead young were found, probably the progeny of three females. There were usually from seven to nine adults around this nest at night.

The nestlings of *C. andrei* have a tendency to beg for food, and to be fed, with their heads hanging downward. They sometimes sleep in this position.

Begging reactions in nestlings of *C. andrei* were released both by wing noises of adults and by drafts of air.

Sitting at night by both adults on a nest containing eggs was noted in *C. cinereiventris.*

When distrubed, *C. andrei* gives loud single wing snaps, produced by hard beating of the wings. Other noises heard in chimneys in Brazil occupied by swifts are a "thundering" or rumbling and a crackling, to be observed only under certain acoustic conditions.

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Fundaçao Brasil Central, Avendia Nilo Peçanha 23 III, Rio de Janeiro, Brazil.

FUERTES RESEARCH GRANT OF THE WILSON ORNITHOLOGICAL SOCIETY

Applications for grants during 1960 are now being received. The committee recommending the grants wishes to emphasize that any type of ornithological research may be supported and that recipients need not be affiliated with educational institutions. In fact, the committee hopes to encourage the development of research by amateur ornithologists. The important criterion in making awards will be the potential contribution to knowledge intrinsic in the work envisioned.

Information and application forms may be obtained from Harvey I. Fisher, Department of Zoology, Southern Illinois University, Carbondale, Illinois.

SOCIAL BEHAVIOR AND BREEDING SUCCESS IN CANADA GEESE (*BRANTA CANADENSIS*) CONFINED UNDER SEMI-NATURAL CONDITIONS

BY NICHOLAS E. COLLIAS AND LAURENCE R. JAHN

An attempt is being made to reestablish the Canada Goose as a breeding bird in Wisconsin. This is being done by use of large, outdoor enclosures adjacent to appropriate habitat, in which wing-pinioned adults are maintained. The resulting young birds are not wing-pinioned but are allowed to fly over the surrounding fence, in the expectation that they will settle and breed in the adjoining marshlands. The present study was carried out in an eleven-acre enclosure at the Horicon Marsh Wildlife Refuge, Wisconsin. The main objective was to ascertain to what extent and in what ways loss of productivity in the Canada Goose population at the various stages of the breeding cycle was related to social behavior. With this objective, a detailed study of the social behavior of marked individuals was made.

The set-up and the general plan of the study were established by Jahn, while most of the observations were made by Collias, who also prepared and organized the report. This study was financed by the Wisconsin Conservation Department with federal aid in Wildlife Restoration funds under Pittman-Robertson Project W-6-R. We wish to express great appreciation to Cyril Kabat, Research Coordinator, and James Hale, Chief Game Biologist, of the Wisconsin Conservation Department, for permission to publish the data. Kabat also provided much help and useful advice at the outset of the project. We are grateful also to the other personnel of the Wisconsin Conservation Department who aided this study. We wish to thank Mrs. Elsie Collias for preparation of the illustrations.

Observations on the behavior of Canada Geese in the Mississippi Valley have been reported by Johnson (1947), Elder and Elder (1949), Hanson and Smith (1950), and by Kossack (1950), while Balham (1954) has made a study of the behavior of Canada Geese at the Delta Waterfowl Research Station in Central Canada. In the Western States, Canada Geese often concentrate on islands to nest; losses from intraspecific strife have been reported (*cf.* Hammond and Mann, 1956). Considerable information on the migratory behavior of Canada Geese, a topic not covered here, is available in Hochbaum's recent book (1955).

METHODS

In the spring of 1952, when this study was effected, the enclosure at Horicon contained 38 adult males and 34 adult females, including three pairs known to have bred the preceding spring. There were also a good many wing-pinioned Mallards present, while various kinds of ducks often visited the enclosure from the adjoining marshlands.

In general, adult male geese were distinguished by a red plastic collar fastened by means of snaps around the neck, and also by an

aluminum government band on the right leg. The adult females were distinguished by a white collar, and had an aluminum band on the left leg. The young from each of the preceding two years were similarly and distinctively marked as age classes.

The adult birds were also marked for individual recognition with colored airplane dope painted on the white cheek patch and on the white flanks in various combinations. A given individual was designated by reading first the color of its face, secondly that of its flanks. For example, Male YR, refers to a male with a yellow face and red flanks. Male Y– refers to a male with yellow face, but with flanks unpainted. Young birds as well as adults could also be identified as individuals under favorable conditions by reading the numbers on the leg band with the aid of a 35-power telescope.

In an attempt to increase productivity, artificial nesting sites were provided, made of brush and covered with marsh hay. These sites were located on and about the six-acre pond and labelled as shown on the accompanying map (Fig. 1). The food consisted of a specially prepared diet put up in pellet form, of a calcium source in the form

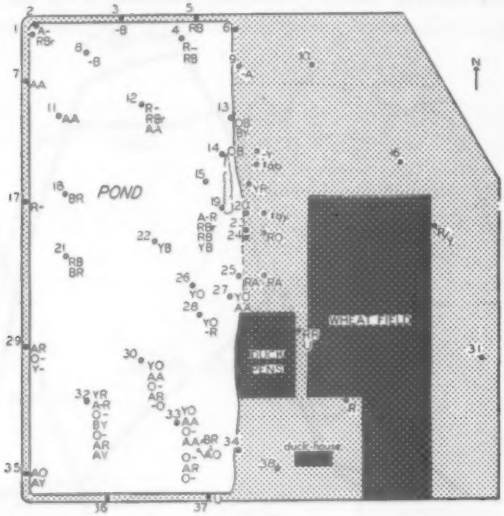

FIGURE 1. Diagram of the eleven-acre enclosure, showing successive territorial occupants of specific nest sites, March-May, 1952. Artificially provided nest sites are numbered and indicated by black dots; a nest built by a female in some other locality is indicated by a dot in a circle. Letter designations refer to males, unless otherwise indicated. The stippled area is land.

of crushed oyster shell, of an abundant supply of greens, as well as various natural forms of aquatic and terrestrial growing vegetation. The pellets and oyster shell were fed to the birds from hoppers. A wheat field was planted in the enclosure at such a time that the young wheat plants became available for grazing by goslings as well as adults.

Observations were commenced on March 14, 1952 and were terminated on May 29, 1952. The actual observations were made from two to four days a week, and ranged from 4 to 13 hours a day, as a rule covering about 8 hours a day. In March there was a total of 70½ hours of observation, in April, 101½, and in May, 104½. The total number of hours of observation forming the basis of this report was 276½.

PHENOLOGY

Some signs of breeding behavior had already begun when observations were commenced on March 14, since some males were seen defending the vicinity of their female from other males. At least half of the pairs were already formed by this time, and probably many of the birds had remained paired during the winter.

The first territorial defense was seen on March 14, but may have

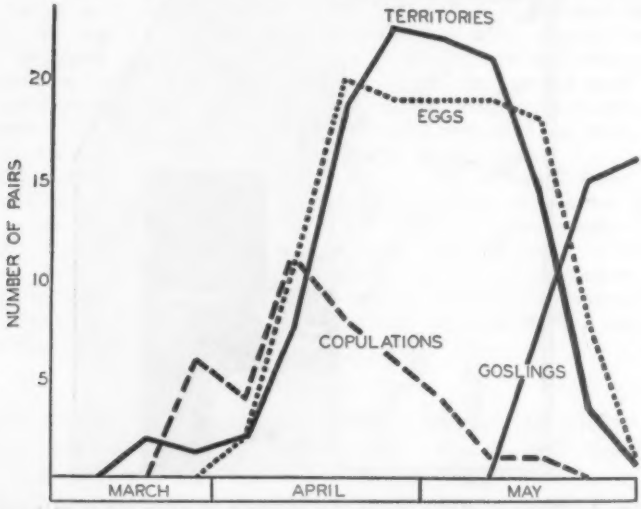

FIGURE 2. Phenology of breeding behavior in the Canada Goose breeding colony at Horicon Marsh, 1952. The ordinate shows the number of pairs of geese seen on territory, copulating, with eggs, or with goslings. This graph refers to all geese in the colony that showed any signs of breeding activity.

occurred earlier. The first copulation was seen on March 26 (by Frank Burrows); the first egg was laid on April 4th; and the first gosling hatched on May 13th. Figure 2 shows in graphical form the seasonal progression in terms of frequency of various breeding activities, including territorial occupancies, copulations, numbers of pairs with eggs, and numbers of pairs with goslings.

The peak of copulations preceded that of territorial occupancies; the latter coincided closely with the peak of egg-laying. Since copulation by a given pair ceases once the full complement of eggs has been laid, the lag in the curve of egg-laying behind that of copulations is as expected.

Since the normal incubation period runs about 28 days, and 5 or 6 days are required for laying all the eggs of a normal clutch, the peak of pairs with goslings should generally come about 33 or 34 days later than the peak of pairs with eggs, assuming a fair degree of nesting success in the population. This time distribution was found to be the case. Of 19 pairs with eggs, 18 laid their first egg in the two-week period, April 6-19, whereas of 16 pairs which hatched goslings, 15 hatched their goslings in the two-week period, May 11-24.

Breeding phenology is of course affected by weather, especially dur-

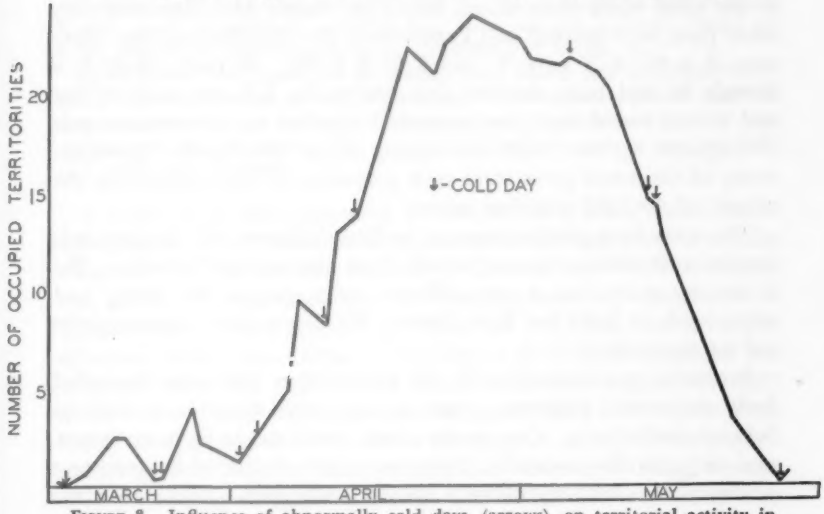

FIGURE 3. Influence of abnormally cold days (arrows) on territorial activity in Canada Geese at Horicon Marsh, 1952. The ordinate shows the average number of pairs on their territories at the start of each observation hour during the day. The graph begins with March 14th.

ing the early part of the breeding season. Adverse weather may delay the onset of breeding activities. Of the various factors of weather, one of the most important is probably temperature. To measure its influence on territorial occupancies, at the start of each hour the observer noted down the numbers of nesting sites that were occupied by geese, and he also took notes on the weather conditions prevailing during each observation day.

Figure 3 shows that abnormally cold days inhibited territorial activity early in the breeding season prior to egg-laying and before all the ice was melted in the pond, but such cold days had little if any influence once the breeding season got well under way, i. e., after egg-laying in the population was well started.

After territorial activity had virtually ceased, the birds flocked together to a greater extent. On the morning of May 29th, the observer counted 56 geese in the wheat field, not including goslings. This was the largest aggregation seen since before the start of the breeding season.

BREEDING BEHAVIOR

Pair formation. Many of the adult geese were apparently paired at the time when observations began on March 14. However, only three pairs were marked and known from the preceding spring; these were R x W, R/Y x W/Y, and R/G x W/G. Of these, Male R x Female W had been checked also during the fall and early winter and it was noted that they remained together as a consistent pair throughout, together with their young of the 1951 hatch. However, many of the adult geese were seen gradually to form pairs with the advent of the 1952 breeding season.

The sexes have similar plumage in Canada Geese, but the female is smaller and differs characteristically from the male in behavior. She is less aggressive, has a very different voice (see p. 486 *infra*), and often tends to hold her head lower. No doubt these characteristics aid sex recognition.

Successful pair formation in the competition for mates depended both on *specific preferences* and on aggressive *dominance relations* between individuals. One or the other factor might be more important in particular instances. *Preferences* were indicated by persistent tendency of a bird to follow a specific individual. *Dominance* was expressed by defense of the vicinity of the female with special reference to potential or actual sex rivals. Some examples will be mentioned.

Male RO took Female W/G, apparently the mate of Male R/G, by repeatedly driving the latter away from her, eventually killing Male R/G. This was the only pair known from the preceding year which was broken up by other birds. Although Male RO was noted to drive Male R/G over 50 times from Female W/G, Male RO generally tolerated a young bird of the previous year next to female W/G and presumably the offspring of this female and Male R/G. Male Canada Geese almost never attack their mates, but on two occasions Male R/G was actually seen to bite at Female W/G in an apparent attempt to drive her from the vicinity of Male RO.

Female AR, who was persistently attended by two males, tended to follow the subordinate male (–O) rather than the dominant male (AO), who limped along behind her, with an old foot injury. Eventually the latter male was defeated and driven from the female by the formerly subordinate male, –O, who thereupon paired with the female.

On the other hand Male AO had for a while the preference of Female –B, who frequently sought his company, in preference to that of subordinate Male YB, who persistently followed Female –B, and eventually won her after revolting against and defeating Male AO in a vigorous and relatively long battle.

For a time these five geese could be seen together day after day, Female AR either leading the assemblage or following Male –O, with Male AO tailing her and with Female –B in turn following Male AO. Male AO spent most of his time keeping the two subordinate males away from the immediate vicinity of Female AR.

Male RB was followed by two females, RB and –A. Female –A dominated Female RB and occasionally drove her from the vicinity of Male RB. She was seen to copulate three times with Male RB, but this male paired with the other female, which he evidently preferred since he persistently followed Female RB about, whereas he often ignored the perambulations of Female –A.

Sexual activity was sometimes an evident factor aiding pair formation. After losing Male RB, Female –A one day engaged in precopulatory display near the unpaired males, AB and BA, each of whom attempted to copulate with her. Male AB defeated Male BA in the fight that ensued, and subsequently soon copulated and paired with the female.

A paired male after aggressive altercations with other males habitually returns to his female and repeatedly honks and emits a snoring vocalization. The honking tends to be directed away from the female and toward the opponent, but the prolonged snoring vocalization is directed toward her, as the male holds his head low and neck outstretched toward her. Once a male began to snore to a female this could be taken as a positive sign that the two were paired, especially if the female joined the male in honking at other birds, often alternating her yipping with his deeper honking so as to give the impression of a duet. Possibly these vocalizations all serve to strengthen and to help maintain the pairing bond. The birds seem very sensitive to vocalizations, and mates know each other's voice, as was suggested one day by an incident near the duck house. The observer came near a group of geese, and only one of these honked, and at once its mate,

which happened to be on the other side of the duck house with some other geese and not visible, honked in reply. Whenever members of a pair that had been separated came together again they almost invariably vocalized together.

Members of established pairs may develop considerable attachment for each other. One male lost his mate during the period of incubation, her death being due to unknown causes. Her body, half-sunken in the water, was discovered one morning, with the male keeping vigil nearby, and well out of his customary territory. Her body was removed, but for two days the male continued to visit and rest near this spot, and he made no effort to pair with any other female during the remainder of the nesting season.

There was some evidence that mates may at times be soon replaced, when lost. Thus, after Male R/Y died of unknown causes, his mate, Female W/Y continued to sit on her eggs for about ten days in the face of frequent persecution by other birds. She then paired with Male YA, one of the males which had been driving her from her eggs, and about this time she also deserted her eggs.

Birds that did not pair normally were likely to seek the company of others of their own sex, resulting in some definite unisexual pairs. This was true of both males and females. There was an excess of unpaired males present in the enclosure. One male attached himself to the caretaker whom he apparently regarded as his mate, for he would drive other geese from the caretaker's vicinity, and give the snoring call (see p. 483 *supra*) only to the caretaker, whereas he would hiss at other humans. He often waited at the gate for the caretaker to appear each morning, and would honk a greeting while the man was still some distance away.

Pair formation was influenced by weather if the pairing was relatively weak and of very recent duration; cold weather tended temporarily to separate such pairs.

Breakup of families. At least six of the pairs were associated with young birds of the preceding year at the start of the 1952 breeding season. In general these families broke up at about the time that the parents started to establish a territory for the new breeding season. However, intolerance toward the young was likely to be manifested shortly before this time, particularly when the birds were hungry during competition for food, since the young birds were then closely associated with the parents. Thus, Male R was observed to drive his own fully-grown young (of the preceding year) from the vicinity of the food over 30 times. These young had been banded the preceding

year and were definitely known to have been raised by Male R and his mate.

The break-up of families depended a little on the weather. On the day that Female R– laid her first egg, there was a snowstorm, and she and her mate left their territory for a while, and were seen swimming toward the food site with their yearling between them. This was the only family reunion noted once territory was well established, and it was of very brief duration, since the yearling did not feed with its parents.

After leaving their families, the yearlings tended to flock together, as well as with non-breeding two-year-olds and adults. The free-flying young geese generally would form small flocks that would leave the enclosure for part of the day, to fly out over the adjoining marshland to varying distances, sometimes out of sight of the observer.

Selection of nest sites. The female usually selects the nest site, leading the male about on exploratory jaunts, getting up on nest islets, and poking about inspecting these heaps of branches, twigs and hay with her beak. But when a desirable nest heap was already occupied by other birds, the male would forge ahead to take the lead in driving the other birds away, and if he was successful the female might then mount the potential nest site and inspect it.

The search for a suitable nest site might take one to many days, depending in part on the availability of good nest sites and in part on the dominance status relative to competitors for specific sites. Male AR and his mate got a late start and were rather low in dominance. They found most of the desirable nest sites already occupied. One morning they were seen to visit nine different nest sites in the space of an hour, being evicted from most of these sites by birds that had already laid claim to the sites in question.

Some birds preferred to build their own nests along the shore, constructing them of dried and dead weed stalks, and largely ignored artificial nests still unoccupied. Two of the artificial nest heaps overturned when the ice melted and the birds showed no interest in them until marsh hay was placed on them.

Nest sites were selected both before and after the ice melted from the pond.

Both of the two pairs whose nesting sites of the preceding year were known nested at about the same location in 1951 and 1952.

Establishment of territories. Once a nesting site was selected both members of the pair generally stayed close by. Their claim was announced to all other geese by loud honking and other threatening

actions, particularly by the male, whenever intruders came near. Typically, the male would sally forth at an intruder in the vicinity, with neck outstretched and head held low. If the intruder stood his ground or came closer, a fight would probably ensue, in which the territorial owner was usually, but not always, the winner. Should he lose, the intruding pair, if searching for a nest site, evicted the resident pair, or if not in need of a nest site, but having asserted their domination, merely continued on their way, perhaps pausing a few minutes to inspect the nest of the vanquished pair. As a rule the owner of a territory successfully drove off intruders without the necessity of a fight; often merely a honking defense sufficed. The intruder would move away, sometimes with the neck fluffed out, whereas the more aggressive bird always kept his neck feathers smooth and appressed. On returning to the female, the male would both honk and utter his snoring vocalization, and the female would chime in with her distinctive voice, her short staccato honks or yips alternating with the louder, longer and more resonant honks of the male. The honking duet was also given as intruders approached, but the snoring sound was more likely to be given after the encounter. The retreating birds were far less likely to vocalize than was the winner, and frequently fell silent.

A special display was often engaged in by the male with respect to intruders. With neck stretched up he would abruptly flip his beak upwards, simultaneously rolling the head, showing off to advantage the white cheek patches. This head-flipping, which possibly serves a threat function, seems to indicate indecision, since it was generally seen at the moment when a bird was likely to change from one behavior pattern to another, for example, from standing in one spot to charging an intruder, or to flight from an enemy. Head-flipping was characteristic of the males, but was only occasionally seen in females. This action was strongly associated with display of the white cheeks, which are a brighter, clearer white in the spring than in the fall. Perhaps this peculiar display, which has a warning connotation as well as threat and mild alarm, evolved from shaking mud from the beak preparatory to flight.

Sometimes when the observer or a goose approached a territorial bird, its body plumage was abruptly raised, and if the intruder passed at too great a distance to provoke an active attack, the plumage was again appressed after a vigorous shake, as if the bird had "shaken off" a state of tension.

A human intruder was treated in much the same way as were intruding geese by a territorial male. A female on her nest frequently

would not honk, but rather hiss repeatedly at a man coming close to her. The male would not only honk and flip his head, displaying his white cheeks, but he would also pump his head up and down just as the female might do. This pumping display (also done against geese) indicates incipient attack, and consists of a vacillation between lowering the head with the base of the neck drawn back slightly to facilitate striking out and a return to a resting position, perhaps not unmixed with fear of the intruder. On a closer approach of the intruder the head pumping would begin to include another component in which the lowered head was thrust out in the direction of the intruder, and finally, should the man persist in his approach to the nest, some ganders would actively attack. The black and blue bruises inflicted by the strong jaws and blows of the powerful wings demonstrated the potency of the male in defending his home and mate.

The role of dominance in the establishment of nesting territories was most clearly demonstrated by instances of circular dominance relations. Thus, in a contest over Nest Site 33 that went on for several days, Male BR would drive off Male AO and his mate; Male BR would then be driven off by Male AA, and in turn Male AA and his mate would be driven off by Male AO (Fig. 1). This cycle would be repeated indefinitely, until some male dominant to all three, such as Male O–, would come along and take over the nest site.

Repeated evictions and repeated attempts at reestablishment on a given nest site, covering a period of time anywhere from a few minutes to several weeks before such attempts were given up, were the rule for birds of relatively low dominance status. The resulting picture was a complex network of movements and shifting ownerships of the more heavily contested nest sites. Figure 1 shows the number of successive owners of different nest sites laying more than momentary claim to these nest sites.

Size of territories varied greatly with the individual bird. Some of the males defended more than one of the artificial nest sites, especially where the nest sites were close together (Fig. 4). In every case the great majority of the territorial defenses of a male centered about the nest site of the female.

The size and shape of territories changed with time and circumstances. At first Male YO defended not only the future nest site of his mate (Nest Site 26), but occasionally he defended the four neighboring nest islets as well. Later, as these islands came to be occupied by other pairs he restricted his defenses to his own nest islet. In

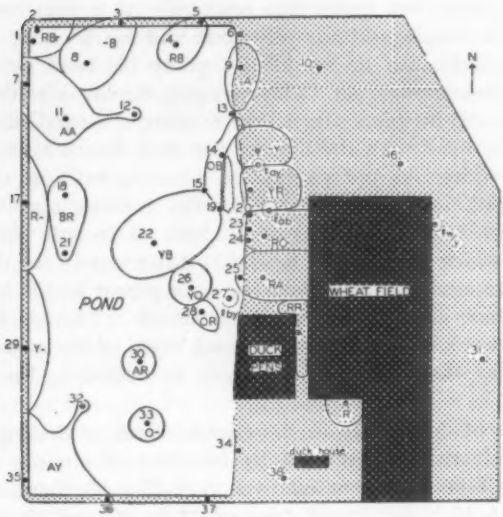

FIGURE 4. Diagram of the eleven-acre enclosure, showing established goose territories on May 1, 1952. Artificial nest sites (black dots) are numbered, ganders are named by letters. Territories of unpaired females are shown by dotted lines about the nest site. The stippled area is land.

contrast, Male RO, which wedged in between two powerful and established males, for a time did not even "dare" to honk, and his female was often driven from her nest during the egg-laying period. But in a few weeks his territory had enlarged considerably, and he soon honked at and later fought with his neighbors, defeating one of them. In general, after a bird defeated its neighbor in a fight the territorial boundary moved in the direction of the loser's ground.

The sound of honking served to excite the aggression of the territorial males. One peculiar case gave a clear example of this. Whenever any geese would honk just outside the bounds of his territory, a certain male would thereupon often attack and drive from her eggs an unpaired female which had her nest at the edge of his territory. The disturbed honking of his own female frequently excited the aggressiveness of a male, and might lead to fights between otherwise relatively peaceful neighbors.

In the pre-egg stage territorial activity was greatest in the early part of the morning (Fig. 5). But this extra activity in the early part of the morning was only slightly, although consistently, greater than at

other times of day. As the season progressed, this slight early morning peak advanced to still earlier hours, as did the sunrise.

Defense of territories about the nest sites by both male and female, but particularly by the male, continued until the eggs hatched, and the young left the nest, after which time the parents seemed to lose all interest in territorial defense.

The importance of the male in territorial defense was made evident by cases in which there was no male to defend the nest site. Female W/Y lost her mate by death late in her incubation period, and although she had been sitting very steadily up to the time the male was lost, her eggs failed to hatch. The reason was that with loss of her guardian she became subject to the domination and disturbance of other pairs as well as of unpaired males, who drove her repeatedly from her eggs, resulting in death of the embryos, presumably from chilling.

Sexual behavior. Copulations were often seen to occur between members of a pair before, as well as after, selection of a permanent nesting site by the pair. When they occurred before establishment of a territory, copulations took place in any convenient stretch of open water with a depth of six inches or more. After territorial establishment the location of copulations was invariably in a portion of the pond nearest the nest site. No copulations were observed taking place on land.

Pre-coitional behavior consists of dipping the head deep under the water and then lifting it and at the same time throwing water over the back with the back portions of the head and neck, in a manner similar to the movements of bathing. But, unlike ordinary bathing, the wings are not used; they are kept folded in their normal resting position. This pre-copulatory display, which may be initiated by either the male or female, gradually increases in frequency and intensity over a period of 30 seconds to two minutes or more. The male works closer to the female, and typically grasps the feathers of the back of her neck as he mounts. The female may keep her normal floating position, or she may stretch her neck down at a low angle with the surface of the water partially or completely submerging during the copulation, which lasts only a moment or two.

Post-copulatory behavior is very characteristic. Both birds stretch the neck up high and inclined slightly backward, with the beak tipped upward, and often rotate so that they face one another, breast to breast. Typically the male half raises his wings without unfolding them, in a swan-like pose, and he then gives a snoring vocalization,

relatively brief and weak, compared with his ordinary greeting snore to his mate. Meanwhile, the female begins to dip her head vigorously into the water and to lift it again, throwing water over her back in exactly the same fashion as in the pre-coitional display. The male then joins her in this. One or both birds may rear up in the water and flap their wings either before or in between sessions of the head-dipping display. After a few seconds to several minutes of this activity, the birds retire together to a nearby spot along the shore and preen themselves.

A two-year-old pair was seen to copulate in the breeding pen, and the details of their behavior were essentially similar to the situation in adults. Yearlings sometimes engaged in the head-dipping movements in quite typical pre-coitional fashion, and once one yearling was seen to mount another, but immediately after dismounting neither bird assumed the typical "swan-like" pose, as adults would do right after a successful copulation. The sex of neither of these yearlings was known.

One male (–Y) was habitually attended by two females (OA and AY), and he was seen to engage in the pre-coitional display with both females simultaneously, but when the display worked to its climax, surprisingly enough one of the females, OA, mounted and apparently copulated with the other female, AY, but there was no post-coitional display.

As this case suggests, copulatory behavior, in the excitement engendered by the pre-coitional display may sometimes be remarkably undiscriminating. In another case where one pair of adults engaged in pre-coitional display, a two-year-old nearby joined in the display and then mounted and copulated with the adult female. Immediately following the copulation the two-year-old bird "swanned" his wings and gave the characteristic post-coitional vocalization.

Sexual behavior was contagious, and the pre-coitional display was likely to set off similar behavior in both paired and unpaired birds in the vicinity. Similarly, copulations by one pair sometimes appeared to stimulate copulation by other pairs.

Unisexual pairs of males or females not infrequently engaged in pre-coitional display, but none of these displays was ever seen to lead to copulation.

It was our impression that copulation was likely to be least disturbed when it took place on the home territory. Pairs not yet established on their own territory were sometimes interfered with during the phase of pre-coitional display, and driven away by some more dominant bird.

Like territorial occupancy in the pre-egg stage, the frequency of copulations tended to be well distributed throughout the day, although there was a slight early morning peak (Fig. 5). Early in the

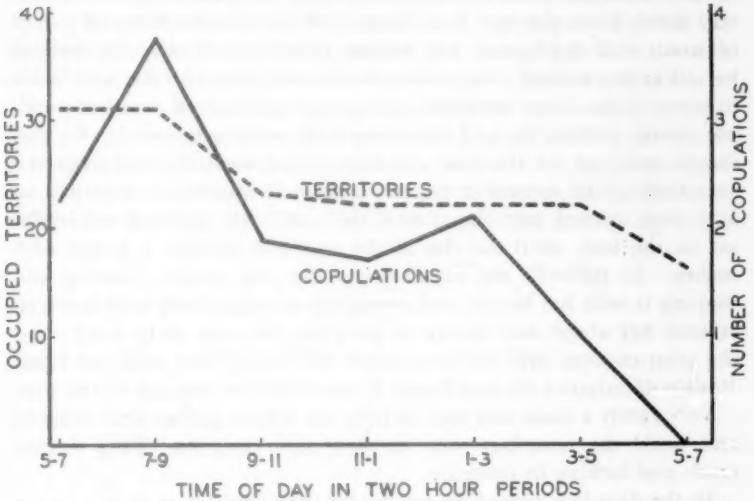

FIGURE 5. Time distribution during the day of 52 copulations and of territorial activity in the pre-egg stage in Canada Geese. The number of nest sites occupied by geese was recorded at the start of each hour of observation. The number of copulations seen and the number of territories occupied are given per 10 hours of observation (ordinate) and the data are summarized by two hour periods for time of day (abscissa).

breeding season copulations were seen most frequently during the warmest parts of the day, whereas later in the breeding season most copulations were seen in the cooler part of the morning. Thus, 8 of 12 copulations observed before the ice in the pond was all melted (before April 2), took place between 11 a.m. and 3 p.m. But only 10 of the remaining 40 copulations seen (in April and May), took place between these hours, and 21, or more than half, took place before 10 a.m.

Nest-building and egg-laying. One female was watched building a nest in a site entirely of her own selection and with nesting materials not provided for her. After rounding out an initial depression in the earth, she gathered nesting material as far as her long neck could reach, stretching out and breaking off small pieces of dead weed stalks, 3 to 6 inches long, with her beak. She then passed each piece

of weed stalk from one side to the other across her breast, continuing the movement backwards along one side of her body and dropping the material onto the rim of the nest. After exhausting the supply of nest material within convenient reach she rose and worked her way slowly from the nest to a distance of six feet, breaking off pieces of weeds and dead grass and tossing them to one side and behind herself as she worked along. She would then return to the nest, work in some of the added material, get up and again work over her previous route, picking up and throwing back nesting material. By this means, material for the nest was moved in toward the nest from the surroundings in successive relays. This nest material was pulled in and then worked into the rim of the nest with the beak while she sat on the nest, until the rim of the nest had reached a height of 5 inches. At intervals she rounded out the nest hollow, turning and shaping it with her breast, and sometimes scraping back with her feet. It took her about four hours to complete the nest (6-10 a.m.), and she then covered over the completed and empty nest with her beak. Within 45 minutes she was found to have laid her first egg in the nest.

Very rarely a male was seen to help the female gather nest material and build the nest, but even in these rare cases his efforts seemed crude and lacking in intensity.

In the days just preceding egg-laying, the female may show a strong urge to graze, spending an increased portion of her time during the day grazing. The male on the other hand continues his normal strong attachment to the territory, and in some cases where the nest site was separated by some distance from the grazing area, the male was seen repeatedly calling and trying to lead the female back to their nest site.

Female W was checked daily for egg-laying by the caretaker, George Amelong. She laid one egg a day except for the fifth day, on which she did not lay. Females do little sitting on the eggs until the clutch is completed, but the eggs are carefully covered after each one is laid.

The average clutch size for 17 pairs of geese in which the female was an adult (3 or more years old) and was probably not interfered with during egg-laying (as was Female W/G by Male YR and Male RA) was 5.2 eggs.

As a rule, down is not added until after 3 or 4 eggs have been laid, although different females vary in this respect. Female AA added down after laying only 3 eggs, and on the same day Female W with 4 eggs, and destined to lay a larger clutch than did Female AA, had as yet added no down. The down is plucked from the breast with the beak, and not only down feathers, but some breast contour feathers may be added as well.

Nest building continues to some extent throughout the period of incubation. A female, while sitting on her nest, may reach down to the outer and lower border of the nest, pick up nest material in her beak and then deposit it on the rim of the nest close to her body. This procedure, combined with occasional scraping back with the feet used alternately, results in a typical low cone-shape to the outside of the nest, and prevents the nest from becoming flattened down.

Incubation. During the egg-laying period the female comes to sit on the eggs more and more of the time, until finally when the clutch is completed she sits on the eggs almost continuously, except for brief rest periods. At the same time pre-coitional display and copulatory activities cease (Fig. 6). The female does all of the incubating, while

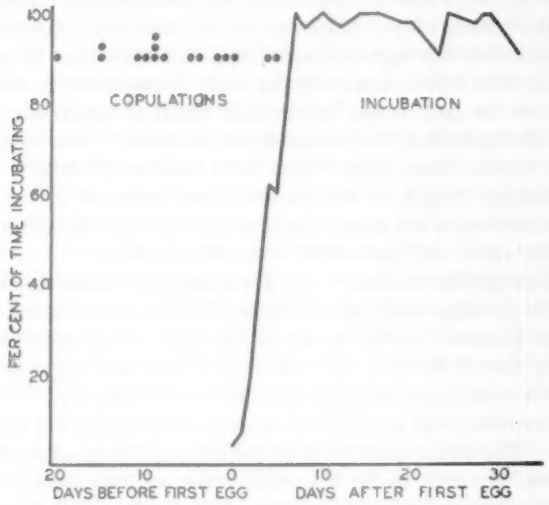

FIGURE 6. Inverse relationship between sexual (copulations) and parental (incubation) behavior in Canada Geese. Each dot refers to one copulation seen on that day. At the start of each observation hour it was noted for each female whether or not she was on her eggs. Only 11 pairs that were seen to copulate and also to incubate eggs are included.

the male stands guard nearby. She was not usually seen to leave her nest more than two or three times a day. She leaves in order to rest, feed, drink, bathe and preen. Her absence from the nest varied in length from four minutes to over two hours, usually being less than one hour.

When a female left her nest and eggs, the event was made quite

conspicuous by the male who would honk loudly while accompanying her. The male gave the impression of being disturbed by the absence of the female from her nest, and he frequently tried to lead her back to the nest before she was ready to return, and when she did return, he served as a honking escort.

On reaching her nest the female almost invariably would stand over the eggs preening her belly and lower breast and apparently working loose some feathers, since a bare area soon appeared from the midline of these areas and increased in lateral extent day by day, during the first part of incubation. The habit of the female of standing over the eggs soon after leaving the water may also help dampen the eggs and improve their hatchability.

Should the eggs fail to hatch after the normal 28 days incubation period, the female may continue to sit for some time. One unpaired female with infertile eggs continued to sit on these eggs for a total of at least 35 days before deserting her nest. Female W/Y, whose mate died before the end of her incubation, failed to hatch out her eggs, because of repeated disturbances by other birds. She continued to incubate despite these disturbances for a total of 37 days.

The average length of incubation from the date of the last egg until completion of the hatch was 28.6 days for eight broods of Canada Geese, for which the dates were accurately known.

Parent-young interactions. (a) *Hatching and initial acquaintanceship.* The goslings hatch over a range of about a day, much less than the range involved in the laying of the eggs. This difference is undoubtedly due to the fact that the female does not begin very steady incubation until all of the eggs have been laid (Fig. 6).

After hatching, the goslings are usually brooded in the nest for the first day. The down soon dries in the nest, but even when dry a very young gosling needs to be kept warm, and quickly becomes cold to the hand when removed from the parents. Reasoning by analogy from work with various ducks (Collias and Collias, 1956), we suppose that this initial day in the nest permits the young ones and their parents to become acquainted and conditioned to each other, and serves later to help maintain family unity, after the goslings leave the nest.

(b) *Leaving the nest.* After the first day, the goslings leave the nest, in part due to their own exploratory tendencies and in part due to parental encouragement and example. When the female steps off the nest and moves a little to one side, the goslings tend to follow, as they would any large object moving slowly away from their imme-

diate vicinity. Thus, a one-day-old gosling removed from its family to be weighed, when placed on the ground right after being weighed, did not at once return to its parents and siblings, plainly visible at or near the nest site some 40 feet away, but instead followed the human observer as he walked off in nearly the opposite direction from its natural parents.

Parental vocalizations may also serve to lure the goslings from the nest when necessary. Excursions from the nest at first amount to only a few inches or a few feet, and the goslings repeatedly return. These excursions are gradually extended to greater and greater lengths, and within a day or two expeditions might be undertaken to any part of the 11-acre enclosure. In the family progressions, the young goslings move along in a compact group between both parents. Usually the female leads, while the male takes over the lead when the situation calls for aggressive attack or defense. During the first few days after leaving the nest, the parents would usually lead their brood back to the original nest to be brooded for the night.

(c) *Initial self-maintenance activities.* The goslings must feed and drink for themselves and be able to seek safety on the water with the parents, after they have left the nest. Goslings that had not yet left the nest were often seen to bite at green grass blades and other green vegetation overhanging the nest, but usually they did not seem able to tear off and eat anything as a result of such mouthings until after they had left the nest. On first leaving the nest two broods of goslings were seen to go to the edge of the water, drink, enter the water and swim about, all for the first time in their lives, without the inducement of parental example or leading, although the initiation of such activities might often be facilitated by parental example.

The goslings fed largely on wheat sprouts in a wheat field that had been planted for their benefit, leaving alone thistles and most other weeds in the field. They also fed on fresh green sprouts of various plants along the muddy shoreline, and on submerged aquatics. Where the water was too deep for the goslings to reach the submerged aquatic plants the female was seen in one case to reach down and pull up the plants, while her downy young ones fed on bits of the plants which they pulled from her beak. A few days later these same goslings were observed to tip up, pull up and eat water weeds in the shallow water near shore, on their own initiative.

At the food hoppers where pellets containing a prepared diet for the geese were fed, the parents seemed to be powdering up the pellets, making it easier for goslings less than a week old to feed on the material.

(d) *Maintenance of family unity.* When lost or otherwise separated from other geese, a gosling would give loud and repeated distress calls, sounding quite like the peeps of lost baby chicks of the domestic fowl. These distress notes attracted the parents. When reunited with its family a gosling would promptly switch to contentment notes, somewhat reminiscent of the contentment or pleasure notes of chicks of the domestic fowl (Collias, 1952).

During the first week the goslings were brooded quite often during the day; after the first week it was evident from general observation that they were brooded less frequently, although no data were assembled on this point. All of the females brooded their downy goslings when it rained, and at night.

In defense of their goslings the parent geese, especially the male, often attacked other geese that came too near the family; the male sometimes even attacked human beings. Interestingly enough, in defending their goslings, parent geese, unless at a very high pitch of excitement, ordinarily did not honk. This relative lack of honking was in marked contrast to their raucous behavior while maintaining territory. Honking by another goose on or near its territory seems particularly to stimulate aggressiveness of a goose, and evidently absence of honking in parent birds serves often to give them and their young ones safe passage across the territories of geese that had not yet hatched out their goslings.

Parent birds, as well as goslings a week or more old, would attack strange goslings that ventured near, especially if there was a wide discrepancy in size from goslings in the family, permitting ready recognition of strangers as such. Adoptions of strange goslings were most likely to occur when both own and strange goslings were less than one week old, and of about the same size. These younger goslings have apparently not yet become thoroughly acquainted and attached to a specific parent bird, nor their parents to them. Adoption is also facilitated by dominance of the foster parents. When a gosling accidentally gets into another brood and is allowed to remain with that brood, its parents may be thwarted in their endeavors to get it back, by the aggressive attacks of the other parents defending the vicinity of their own brood. Usually, however, the original parents succeed in calling their own goslings out of another brood with which they might have intermixed, and goslings possibly recognize the voices of their own parents. Whether or not the gosling stays with and is permanently adopted into the other brood depends in part on the degree of attachment of the gosling to its own parents, and in part on the

degree of attachment or indifference of the parents to their goslings, as well as on other circumstances, such as the degree of tolerance or intolerance of the foster family towards the newcomer. Adoptions were rare in the case of goslings more than one week of age.

Relatively permanent adoptions were common in the somewhat crowded conditions prevailing within the breeding pen, and three pairs of birds lost their entire broods through adoption by other parents. The family of Male Y– and Female Y–, a particularly dominant pair (Table 1), grew larger each week, and by the time their own goslings were a little more than two weeks of age, their total brood had increased by adoption to some 20 goslings, about three times the original size of the brood.

As the goslings grew older their aggressiveness greatly increased. When less than a week old they would hiss at a human captor, and when over a week of age, battles between goslings were not infrequent. Strange goslings from other families were particularly prone to be attacked, but fights sometimes involved members of the same brood. It was not long before the goslings seemed to share to some extent in the dominance status of their parents, and it was remarkable to observe a downy gosling only about two weeks old forge well ahead of its father to drive an adult gander away from the food hopper.

Interrelationship of different behavior patterns. Reproductive behavior in the Canada Goose, as in many other birds can be divided into the sexual phase and the parental phase, perhaps also dominated by sex hormones and prolactin, respectively (*cf.* Collias, 1950). Figure 4 illustrates the inverse relationship between the sexual and the parental phases of reproductive behavior in Canada Geese. Once the complete clutch has been laid, copulations soon cease and pre-copulatory displays become rare. Relative predominance of sexual activity or of parental activity does not however imply mutual exclusiveness, in an all or none sense. Some behavior patterns, like that of territorial aggressiveness, seem to belong to both the sexual and the parental phases. It is not unlikely that a certain amount of gonadal endocrine activity continues in males while the female is incubating, and that this may be responsible for much of the aggressiveness of the male.

Excitation of one drive may sometimes lead to some secondary excitation of another drive. Thus, after the termination of a territorial fight between males, the female of the territorial owner (generally the winner) may go into a frenzy of pre-copulatory display, but such display was not seen to lead to copulation. An unpaired female,

which was often driven and kept for a while from her nest and eggs by an adjacent dominant male, meanwhile often stood five or six feet to one side and picked up and moved back dead weed stalks in typical nesting movements. This apparently irrelevant or displacement behavior would seem to point to a close relationship of some sort between the nest-building and the incubation drives in these geese. Tinbergen (1940) has reviewed quite similar instances in other birds.

VOCALIZATIONS

Some ten or more different vocalizations were observed in Canada Geese. These sounds are listed below, together with the situation that seemed to provoke each. This list is not intended to be exhaustive.

1. *Hiss.* Directed against other geese, ducks, and especially against humans near the nest. Apparently signifies threat and alarm at *short distances.* For example, one female on her eggs repeatedly hissed at the observer when he approached within a few feet, and then switched to honking when he moved off, reverting to hissing each time the observer returned close to her.

2. *Honking.* The honking of the male is loud and resonant, and each honk seems to be relatively prolonged, as compared to the short, staccato honking or yipping of the female. It is probable that spectrographic analysis would reveal characteristic differences in the frequency components in the voices of the two sexes. Geese characteristically honk in at least five different situations: (1) in territorial advertisement and warning to intruders, (2) as a *long-distance* call or answer to the mate when separated by more than just a few feet or yards, (3) as part of the greeting ceremony when mates come together after having been separated, (4) as an alarm call when a man or dog, for example, approaches a wild flock, or when a gosling is threatened or seized by a man and gives its distress calls, and (5) in flight or when about to take flight. The honking seems to be of the same essential character in all of these situations, although it is possible that significant nuances of this vocalization under different circumstances have escaped the observer. There seem to be two common elements in the various stimulating situations, first, some element of *alarm,* and secondly, functioning of the call over some *distance.* In the case where geese honk in flight one may reasonably assume that fear of separation from companions provides the occasion for honking, just as a flightless male may honk down his free-flying mate when she takes wing. The alarm and the distance functions of honking may

help to explain the loudness of this call compared to others, and its strident and high-pitched character.

3. *Short-distance call of the mate.* This call is a low, short, rather soft grunt, given repeatedly, about once a second: *kum! kum! kum!*, etc. Sometimes it is double-noted, sounding like *wah kum!*, the first note being low and brief and the second, higher and abrupt. A free-flying male was observed to give the short-distance low call on trying to get his wing-pinioned mate to fly off with him, but when he actually began to run into the wind and took off, he switched to the usual loud honking. Another example may be cited. A female left her nest and eggs to drink, and then she swam toward the food site, while the male trailed up to 50 feet behind her repeatedly calling *kum! kum!* in an apparent effort to induce her to return to her nest. He continued to lag, and soon the mates were separated by a considerable distance, whereupon he suddenly began to honk loudly, and swam rapidly to join the female as she came near the feeding area. Both sexes give the short distance call.

4. *Short distance call to the goslings.* This is a rapid series of short, low, soft grunts, quite similar to the preceding call, but often faster and not so loud. Possibly it is the same call. Either sex may give it, but it is most often heard from the female.

5. *Special greeting call for the female.* This rather loud, prolonged, snoring vocalization is peculiar to the male who directs it only to his mate. It is heard when a pair has just formed, and whenever the male and female come together after a period of separation, whether or not any aggression against other geese was involved. Possibly it functions to reinforce the pairing bond.

6. *Post-copulation call.* Immediately following copulation the male gives a brief, light snore, while assuming the characteristic posture that has been described in preceding pages.

7. *Scream of pain.* An abrupt, high, rather short scream, heard when one gander was taken by surprise and received an unexpected bite from another.

8. *Distress call of adult.* A loud *oh!-oo, oh!-oo,* etc., heard when one bird was seized, held and bitten by a dominant bird. It was sometimes heard when a bird was separated from its mate by a fence.

9. *Distress call of gosling.* A loud peeping, typically given when a gosling was lost, or was removed from its family by the observer.

10. *Contentment notes of gosling.* A light, rapid series of soft notes: *wheeoo, wheeoo,* etc., given, for example, when the gosling was returned to its family.

DOMINANCE ORDER

These birds show a dominance order which centers in good part over competition for food. In competing for food one bird would advance at another, often honking at the same time, and as it came near, the aggressor would lower its head nearly to the ground, and with the long neck outstretched, except for its basal portion curved back ready to strike, the bird would charge with open threatening jaws at the goose it intended to displace or keep away from the food. Should the bird which was attacked retreat it was adjudged to be subordinate. No interaction was tabulated unless one bird was definitely the aggressor, and the other definitely retreated. Rarely, a bird threatened failed to retreat, and ordinarily a fight for dominance then ensued in which the contestants attempted to seize and hold each other by the base of the neck with the beak, meanwhile repeatedly administering powerful blows at each other with the wings. A fight

TABLE 1

DOMINANCE ORDER OF 38 MALE CANADA GEESE AT HORICON MARSH IN THE BREEDING SEASON OF 1952

Domination-subordination ratios (d:s) are shown for various degrees of breeding success. The d:s ratio for any given male refers to the number of birds dominated (d) and the number of birds to which that male was subordinate (s).

Male	*d:s ratio*	*Male*	*d:s ratio*
Males which held territory:			
Mate hatched out goslings (aver. d:s ratio of males, 15:7)			
R	19:1	YR	16:7
AY	31:1	–Y	12:9
–B	18:2	RR	8:7
Y–	21:3	RB	10:10
YO	21:7	–A	8:9
RA	12:4	RO	9:11
OB	15:5	OR	7:9
R–	19:7	BR	7:20
Eggs of mate lost (aver. d:s ratio of males, 7:11)			
BY	5:2	–R	5:17
R/Y	12:9	Red-breast	2:12
YB	11:15		
Mate did not lay eggs (aver. d:s ratio of males, 8:10)			
O–	14:8	AA	6:8
–O	18:14	A–R	3:5
AR	11:12	AB	3:7
AO	8:10	A–	1:19
Males which failed to hold territory and to pair effectively (aver. d:s ratio, 3:13):			
OO	6:12	YA	2:11
YY	3:12	BB	2:13
BA	3:13	OA	1:10
B–	4:14	OY	0:9
R/G	4:19		

attracted the attention of and excited other geese, some of which would honk, while those nearby were likely to orient themselves towards and watch the contestants.

The dominance hierarchy that resulted was reinforced by aggressive-submissive interactions at food, and was habitual and consistent as a rule, although some 18 reversals were observed during the breeding season, probably often due to competition for mates. It was not always possible to separate aggressive competition for food from defense of the vicinity of the mate, since early in the breeding season at least, mates ordinarily accompanied each other to the food area.

Both male and female adults as well as younger birds had their place in the dominance order. However, males almost never attacked their mates. Since the dominance of the male over other males seemed crucial for nesting success, emphasis was placed on ascertaining the dominance order of the males as shown in Table 1. The number of paired relationships possible among the 38 males of this table was 703, as calculated by the formula, $n(n-1)/2$, and of these relationships there were observed 345, or about half.

Circular dominance relations were not uncommon. Thus, Male R dominated Male AY, which dominated Male R/Y, which in turn dominated Male R.

The female and young birds of a family to a considerable extent shared in the male's dominance, although when they were not in his immediate vicinity their status was likely to be altered, especially when they attempted to attack ganders.

Role of Behavior in Reducing Breeding Success

The factors reducing productivity in the breeding colony at Horicon were almost entirely factors connected with social behavior. Predation and mortality from parasitism were apparently nil, although the pen was surrounded merely by a fence enclosing one corner of the marsh. (However, two adults died from unknown causes.) Flooding was not a factor in loss of any nests, nor was weather the cause, directly or indirectly, of any losses, although the birds were just as exposed to the elements as they would have been had there been no fence about them.

One pair of two-year-old birds successfully hatched out six goslings on top of a muskrat house in the marsh some 150 yards south of the enclosure. This pair is not included in this account which refers entirely to conditions within the breeding pen.

Factors reducing productivity at each stage of the breeding cycle.

With respect to success in breeding, the geese may be grouped into five categories: (1) pairs that hatched out goslings, (2) pairs that laid and incubated eggs, but failed to hatch young, (3) pairs that held territory but failed to lay and incubate eggs, (4) pairs that failed to establish territory, and (5) geese that failed to pair normally.

Table 2 summarizes the gains and losses within the breeding pen during the breeding season of 1952. There were 73 adult birds on hand at the start of the breeding season; also included in the tabulation are one pair of two-year-olds that laid and incubated eggs, and a couple of two-year-olds, each of which paired with an adult bird, making a total of 77 breeders to be considered. Within the pen, 16 pairs hatched 71 goslings.

TABLE 2

GAINS AND LOSSES OF CANADA GEESE IN THE BREEDING PEN AT HORICON MARSH, DURING THE BREEDING SEASON OF 1952 (TO MAY 29TH)

	Gains	*Losses*	*Per cent loss*
Adults present at start	77		
Adult mortality		3	4
Eggs laid (23 clutches)	133		
Eggs lost:		62	44
Dropped eggs		6	
Clutches lost (seven)		35	
Infertile eggs of successful pairs		10	
Inviable embryos of successful pairs		11	
Goslings hatched (by 16 pairs)	71		
Gosling mortality		5	7

It may be seen from Table 2 that egg loss was the greatest source of loss, considering gross age categories, since only 4% of the adults and only 7% of the goslings were lost (to May 29, 1952), whereas 44% of all eggs laid were lost.

It is useful to consider the relative losses in *theoretical* breeding potential that occurred at different stages of the breeding cycle, since this type of consideration helps us to decide just where and when most of productivity is lost. Table 3 shows the different percentage losses at each stage of the breeding cycle, assuming a clutch size of 5 eggs. This table brings out the importance of factors concerned with failure to lay eggs, at least in nests. Over half the birds assumed to be capable of breeding failed to make nests in which they laid and incubated eggs; one-fifth of the birds failed even to pair up effectively. The nine pairs that failed to lay eggs in nests were involved in unusually frequent territorial clashes, and most of them were unable to maintain stable territories for any length of time. Four of the 5 pairs

(and perhaps all 5) that lost their clutches did so because of disturbance to the female from other geese, related to a lack of effective male defense. It would seem that over half the loss in breeding potential could be ascribed to factors having to do with territory, *i. e.*, to lack of effective territorial establishment or defense (Table 3). The possible alternative is that many of the females that were sufficiently motivated to defend territories and to copulate, for some reason were not sufficiently in breeding condition to lay eggs. These two explanations are not completely antithetical.

If we take 5 eggs as a general figure for average clutch size, the 41 males and 36 females present should have raised 180 goslings, instead of only 66 (to May 29), as their theoretical breeding potential. Tak-

TABLE 3

RELATIVE LOSSES IN THEORETICAL BREEDING POTENTIAL AT VARIOUS STAGES IN THE BREEDING CYCLE, ASSUMING THAT EACH PAIR OF ADULTS COULD HAVE RAISED FIVE GOSLINGS

	Numbers lost	*Per cent of total*
Failure to pair effectively (11 males and 5 females, equivalent to five pairs)	25	20
Failure to lay and incubate (9 pairs)	45	37
Loss of entire clutch during period of incubation (5 pairs)	24	20
Inviable and infertile eggs in nests otherwise successful	21	17
Gosling mortality	5	4
Adult mortality	3	2
Totals	123	100

ing into account a slight adult mortality, it may be calculated (123/180 $\times$ 100) that about 70% of the theoretical increase in population was lost (Table 3).

Although failure to lay eggs, as well as loss of eggs once laid, was the most important source of loss in productivity, the breeding potential was frittered away to a greater or lesser extent at all stages of the reproductive cycle. It is pertinent to consider in more detail the various mechanisms involved at each step in the cycle, insofar as these mechanisms could be observed or deduced.

Geese (including Males R, R–, AY, Y–, YR, and R/Y) with a previous history of rearing families successfully, were among those likely to succeed again. But we did not know the breeding history of many pairs. Part of the reason for the success of experienced birds was their relatively high dominance status (Table 1).

The evidence that high rank of the male in the dominance hierarchy during late winter and early spring increases the chances of an

individual male and his mate to breed successfully is shown in Table 1.

Twenty per cent of the loss in breeding potential came from failure of some birds to pair effectively (Table 3). As Table 1 indicates, part of this reason was probably due to low dominance status. Factors of individual preference and fixation were also important, being true of both males and females.

For some weeks, Female –Y trailed after Male –Y, which was already closely attended by Females AY and OA; he preferred (often followed) and paired with Female OA. Both Females AY and OA dominated Female –Y, and occasionally would drive her back away from the vicinity of the male. Female –Y eventually stopped following this or any other male, but Female AY laid, and for 35 days incubated, a clutch of infertile eggs at the edge of the territory of Male –Y x Female OA. But the male never defended Female AY directly from other males; he occasionally drive her off her eggs himself.

The same type of situation but in the opposite sex, was manifested by Male –O, which persistently maintained his interest and fixation with respect to the apparent mate of Male AO. Eventually he defeated Male AO in this competition, but so late in the season that none of these three birds managed to breed.

Unisexual attachments among seven males, as well as in two of the females may also have acted to delay normal pairing with the opposite sex, until advance of the season made successful breeding impossible.

Male RY and Female AB showed very little interest in specific individual geese, for unknown reasons.

Male OO became attached to the keeper, and thereafter made no attempt to pair with any goose.

Only one of the unpaired geese, Female –A, was seen to copulate.

Thirty-seven per cent of the loss in breeding potential was due to failure of nine pairs to lay and incubate eggs (Table 3).

One of these pairs included a non-territorial adult male which was wing-pinioned, but paired with a free-flying two-year-old female. The latter bird often flew off with a two-year-old male, leaving her adult male alone much of the day. The other 8 pairs (including Males O–, AR, AO, –O, AA, AB, A–R, A–, and U), although they defended territory, seemed unable to hold a stable territory for any length of time, and shifted about a good deal from place to place (Fig. 1). In these pairs one female, AR, was first mated to Male AO, and then to Male –O. Male O– was the most dominant male of these pairs that defended territory but did not lay, and was probably capable of holding territory long enough to breed, but his mate, Female O–, refused to accept the nest site (33) that he defended most often. This nest site, although it appeared to be suitable in terms of construction and materials, and seemed to be popular with many pairs (Fig. 1), was located in the main line of traffic of the geese going to and from the feeding area from various parts of the pond.

Part of the reason for failure to lay eggs might have been due to fixation on specific nest sites, involving considerable and often unsuccessful competition, until with advance of the season the physiological state of the birds changed in a direction unfavorable to egg-

laying. Furthermore, pairs that were most often displaced from nest sites were also the ones that generally did not lay eggs. These evictions were related to low dominance. The domination-subordination ratio per male was 7:11 for 13 males evicted from at least one nest site at which they had spent most of one day or more trying to establish themselves, whereas the d:s ratio was 15:7 for 16 males which were never so evicted, and which for the most part bred successfully.

Failure of normally paired geese to lay eggs was not due to lack of copulation. There were observed 21 copulations by 11 pairs that failed to lay and incubate eggs, for an average of 1.9 observed copulations per pair, and 10 of these 11 pairs were seen to copulate. In contrast, for 21 pairs that laid eggs which were incubated, there were observed 24 copulations, an average of only 1.1 observed copulations per bird, and only 14 of the 21 pairs were seen to copulate.

Inadequate diet or lack of food does not seem a likely explanation for failure of some birds to lay eggs. At least the food was provided in some abundance, and was adequate for egg-laying by many of the females, as well as for a high egg production by the many Mallard ducks maintained for this purpose within the same large enclosure. All of the Canada Geese dominated the Mallards, and had precedence to food over all ducks.

Perhaps the six dropped eggs found belonged to birds not able to maintain a stable territory, but attempting to lay in some other bird's territory, since all of the six dropped eggs were found within occupied territories in which the resident female laid a full clutch of her own. Furthermore, females were seen on two occasions to be repeatedly attacked by males, just before the female laid an egg in her own nest at the edge of the territory of the attacking male.

Twenty per cent of the loss in breeding potential was due to loss of the entire clutch by five pairs of birds (Table 3).

Four of these five clutches were lost as a result of evictions of the pair from its territory or of the female (of Male R/Y, who died) from her nest by more dominant birds. The fifth clutch, that of Male YB x Female B–, was lost with the death from unknown causes of the female, after three weeks of incubation. Although not observed, possibly dominance by other geese was involved here also, since the male coincident with the death of the female, lost all of his tail feathers. This phenomenon was noted in the breeding season, only when a male had lost a severe fight and was pursued by the victor, which would often seize the tail feathers of the retreating loser, sometimes pulling out some of these feathers. One of the evictions involved a two-year-old pair. A few days after the male had been beaten and the female evicted temporarily from her nest by a neighboring male, the nest was observed to be deranged and the eggs were out of the nest. The two-year-old female rolled one of these eggs toward herself, but since she was

standing to one side of the nest, the egg rolled into the water instead of into the nest cavity. Soon afterwards the dominant pair came and displaced them from the nest, and shortly after this the remaining egg was seen sinking in the water.

Seventeen per cent of the loss in breeding potential was due to infertile and inviable eggs in nests from which goslings were hatched. Ten such eggs were infertile, while eleven contained embryos that had died in the egg.

There is a suggestion in the data that relatively infrequent coition contributed to the occurrence of the infertile eggs. Eight females laid infertile eggs (not including unpaired females), and only two of these eight females were seen to copulate, for a total of only three copulations. On the other hand, eleven of the females that hatched out goslings, laid only fertile eggs, and all of these eleven females were seen to copulate, for a total of 17 copulations.

The occurrence of inviable embryos showed no connection with inattentiveness of the female during incubation, as measured by the number of times a female was seen to be absent from her nest and eggs, once she had begun steady incubation, as checked at the beginning of each hour of observation. Nine females that had at least one dead embryo in the clutch, were seen to have only 9 such absences from the nest during the incubation period, whereas 7 females with no dead embryos had 12 absences. There may however be some relationship between the clutch size and inviable eggs, and the data suggest further investigation of this idea to be worthwhile. Thus, 8 of the 9 females with one or more inviable eggs each had 6 or more eggs in her full clutch, the average clutch size for these females being 6.4 eggs. In contrast, 6 of 7 females with no dead embryos each laid 5 or fewer eggs, the average clutch size being only 4.9 eggs.

Only four per cent of the loss in breeding potential (to May 29) was due to gosling mortality, including 5 dead goslings. Three of these were from one nest, of which two were found dead on the nest on the date of hatching; the other one made it to shore, but was very weak and was finally abandoned by its parents, which went away with their remaining three goslings. Then another family came along and one of the adults and one of the goslings of this family bit the helpless and abandoned gosling. The latter was then put in a brooder where it later died. Another gosling was found with its head caught in a wire fence and when extricated proved unable to walk and later died in the brooder. The fifth dead gosling was found dead in the weeds along the shore; the cause of death was unknown.

Only two per cent of the loss in breeding potential was in terms of adult mortality, although 2 of the 3 deaths of adults resulted indirectly in loss of an entire clutch. Both of these two deaths, one of a male and one of a female, were due to unknown causes. The remaining death was of an adult male gander, killed by a rival male competing for the same female.

Factors having a regulatory effect on population density. Some fac-

tors take an increasing percentage of a population as density increases (Nicholson, 1935), while certain other factors take a decreasing percentage as density increases. This latter type was probably not operating in the present case, since the geese were already too crowded. It refers to such things as Darling's (1952) idea of a threshold of numbers that must be reached to provide sufficient social stimulation to facilitate breeding in some species of birds. It was indeed observed that sexual display and coition, like most of the activities of the geese, were contagious, tending to spread from one pair to another, but, as previously pointed out, those pairs that failed to lay eggs were seen to copulate more often than those that did lay eggs. This observation of course does not exclude the possible importance of social stimulation to facilitate breeding at lower population densities than that with which we were concerned.

A limited number of nest sites for which the birds compete would be expected to exert density-dependent effect with increase in numbers of birds. Amount of shoreline may be an important factor in providing suitable nest sites for effective breeding. A number of pairs chose to build nests on the shore, before some of the artificial islet nests were occupied. This included most of the more dominant pairs. Ten of 16 nests on or near the shore produced goslings, but only 5 of 12 islet nests produced goslings. It seems likely that in the event of disturbance eggs on islet nests are more likely to be lost by rolling out of the nest into the water. Suitability of the available nest materials is of course important, and islet nests with branches and twigs, but temporarily without marsh hay, generally found little favor.

Increase in the number of nest sites has a limited influence, since, beyond a certain degree of crowding, the territorial space requirements of the birds begin to act as a limiting factor. Aggressive behavior of this type was probably the most important cause of population limitation in the breeding colony under the crowded conditions that existed. Many of the territorial males defended more than one of the artificial nest sites (Fig. 4), effectively preventing other geese from becoming established thereon.

Dominance operated as a density-dependent factor in conjunction with fixation on or preference for a given nest site. The more crowded the population, the more chances there are for two pairs to compete for the same nest site. As Figure 1 shows, some of the nest sites changed occupants and owners repeatedly during the breeding season.

All of these factors operate jointly with seasonal factors that regulate the time of the breeding season, probably including such things

as gradual change in the relative lengths of day and night, as well as temperature and other factors. Subordination to dominating geese, inability to establish a foothold against the resistance of territorial incumbents, unsuccessful fixations on certain nest sites or on certain individuals as potential mates, all serve to delay, and by delay may finally prevent entirely, effective breeding by many individuals.

SUMMARY

The breeding behavior, vocalizations and dominance order of Canada Geese (*Branta canadensis*) confined under semi-natural conditions at Horicon Marsh, Wisconsin, are described in some detail, with special reference to social interactions between individually marked birds.

Pair formation depends both on specific preferences and on dominance relations between individuals. The nest site is selected by the female of a pair; she is escorted in the search by the more aggressive male. Repeated attempts at establishment on suitable nest sites and repeated eviction by more dominant birds is the rule for birds of relatively low dominance status.

When regular incubation begins, copulation ceases. After hatching, the goslings usually spend a day in the nest before leaving. During their first week goslings are apt to become lost, and are readily adopted into some other family. However, the early development of aggressiveness against strangers by the goslings, as well as by their parents, tends to preserve the integrity of each family.

Loss in productivity of the breeding colony was very largely due to the territorial behavior of the birds themselves resisting the crowded conditions. In the breeding season of 1952 at the Horicon Marsh colony, about 70 per cent of the theoretical or potential increase was lost. In turn, this loss was traced mainly to (1) failure of birds to pair effectively, (2) failure to lay and incubate eggs, and (3) to loss of the clutch once laid, all generally as a result of domination by other birds.

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Aves de Caza de Venezuela. Hno. Ginés and Ramón Aveledo H. 1958. Sociedad de Ciencias Naturales La Salle, Mon. no. 4. 236 pp., 18 col. pls., numerous figs. and maps. Price, Bol. 20 or U.S. $6. Editorial Sucre, Caracas, Venezuela. (Available: Sociedad Venezolana de Ciencias Naturales, Apartado 1521, Caracas, Venezuela.) This attractive and well-designed book treats the game birds of Venezuela. All regularly occurring species of Tinamidae (13), Anatidae (18), Cracidae (14), Phasianidae (4) and Columbidae (19), as well as the Common Snipe *(Capella gallinago)*, are described, their scientific and vernacular names given, and their ranges outlined. Valuable information is provided on habitat, and, when available, on nesting and behavior—sometimes based on previously unpublished data. The distribution of each Venezuelan subspecies is illustrated by a map. Most species (many of them little-known) are depicted in color plates, those by A. Almeida of Galliformes being vigorous and attractive. Unfortunately the color reproduction of pigeons is in some cases misleading. The species account for each family is introduced by a discussion of family characters, classification, and a key to specimen identification. In the preface the authors point out the need for biological data, make a plea for conservation, and recommend the sport of "hunting" with binoculars and camera. This work reflects credit on Venezuela as well as on the authors. (In Spanish.)—E. EISENMANN.

TAXONOMIC NOTES ON THE AMERICAN GROUND DOVES

BY DEREK GOODWIN

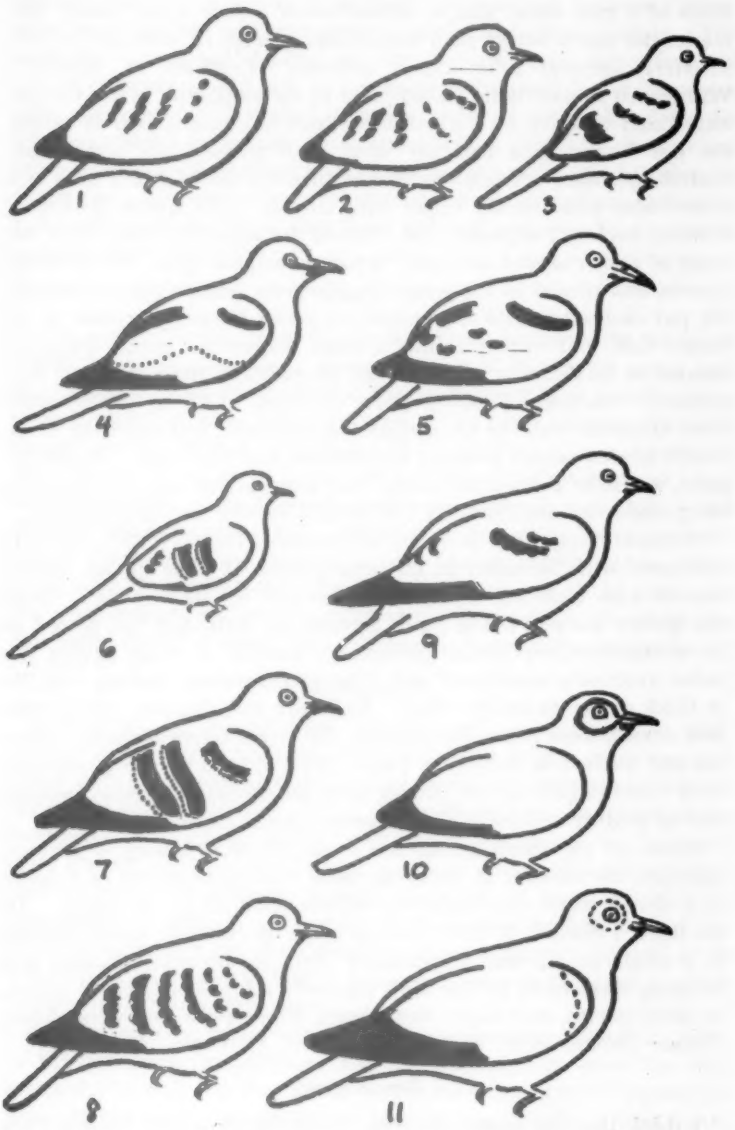
The group of small South and Middle American doves that are usually termed "Ground Doves" show considerable divergencies between some of the species, but all appear to be more closely related to each other than they are to any other pigeons. In the most recent general revision (Hellmayr and Conover, 1942: 505–564) the species involved are called: *Columbigallina passerina, minuta, buckleyi,* and *talpacoti; Eupelia cruziana; Columbina picui; Oxypelia cyanopis; Claravis pretiosa, mondetoura,* and *godefrida; Leptophaps aymara; Metriopelia melanoptera; Gymnopelia morenoi* and *ceciliae; Uropelia campestris;* and *Scardafella squammata* (including *inca*). The recognition of so many genera tends to conceal relationships.

My remarks on these species have, of necessity, to be based on their external taxonomic characters. I have seen only two species alive, *talpacoti* and *cruziana,* and these were in a zoo where I was unable to make any detailed study of their behavior. The little that I have been able to find recorded of the habits of these doves is, with the exception of two papers on the behavior of *talpacoti* (Skutch, 1956, and Haverschmidt, 1953), too fragmentary and uncritical to be of value. From experience with other pigeons with which I am familiar in life or about whose habits and behavior much more is recorded, I am, however, convinced that appraisal and comparison of external characters, particularly of the color-pattern of the plumage, can, and usually does, give a true indication of relationships.

Of the species listed above all, except *morenoi* and *ceciliae,* were placed by Salvadori (1893) in his subfamily Peristerinae. This subfamily he characterized as having "metallic spots on the wings (except in *Metriopelia melanoptera*), size small, much smaller than that of a Common Dove: tail of 12 feathers; the base of the outer tail feathers

FIGURE 1. SCHEMATIC DIAGRAMS OF SOME AMERICAN GROUND DOVES (p. 511). Wing markings and approximate proportions of more divergent species. Only black or iridescent signal markings on coverts or secondaries and those portions of primaries visible when the wings are folded have been shaded black, as have black markings on heads of *picui* and *morenoi.* White areas on wings have been enclosed in a dotted line, except where adjoining a dark marking or the wing edge. A dotted line also encloses bare orbital skin of *melanoptera,* but not that of *morenoi,* which is ringed with black feathers.

1 *Columbina talpacoti,* 2 *Columbina passerina,* 3 *Columbina cyanopsis,* 4 *Columbina picui,* 5 *Columbina cruziana,* 6 *Uropelia campestris,* 7 *Claravis godefrida,* 8 *Claravis pretiosa,* 9 *Metriopelia aymara,* 10 *Metriopelia morenoi,* 11 *Metriopelia melanoptera.*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never of a grey color, sharply defined from a dark apical band; primaries not much longer than secondaries (except in *Metriopelia melanoptera*) general color almost uniform. Confined to America." Within this subfamily he placed *picui* in the monotypic genus *Columbula* (later replaced by *Columbina*), which he characterized as having the tail longer than half the wing, first primary not attenuated; central and outer tail feathers shorter than the intermediate ones and a steel blue band on the upper wing coverts. The species *passerina, minuta, buckleyi, talpacoti* and *cruziana* he separated from *picui* because of their rounded tails and "separate metallic spots" on the wing-coverts, and placed in the genus *Chamaepelia* (later *Columbigallina*). He put *campestris* into the monotypic genus *Uropelia* because of its longer tail, and *cyanopis* into another monotypic genus *Oxypelia* because of its different wing and tail proportions and attenuated first primary. His genus *Peristera* (later *Claravis*), which he distinguished from *Oxypelia* only by its allegedly shorter tail, embraced the three closely related species *pretiosa, mondetoura* and *godefrida*. In *Metriopelia*, which he defined as having "tail short, about half the length of wing, under tail-coverts black", he placed *aymara* and *melanoptera*.

Without recognizing so many subfamilies, Peters (1937: 102–111) concurred with Salvadori in the arrangement of these species, except that he also included *ceciliae* and *morenoi* in *Metriopelia*. These two species (as well as the genus *Scardafella*) Salvadori had placed in his subfamily Geopeliinae, presumably because of their having the tarsus anteriorly scutellated and (like *melanoptera*) lacking metallic or black markings on the wings. Hellmayr and Conover (1942: 510–564) deviate from Peters by retaining the genus *Gymnopelia* for *morenoi* and *ceciliae*, by following Todd (1913: 512) in removing *cruziana* from *Columbigallina* and placing it in the monotypic genus *Eupelia*, and by putting *aymara* in the monotypic genus *Leptophaps*.

When all the above species are compared their affinity is obvious, although the amount of difference shown between certain of them is such that it seems inadvisable to include them all in one genus. All the same, I think it is best, where feasible, to combine several species in a single genus, thus emphasizing their phylogenetic affinities and bringing them more in line with currently accepted criteria of genera in other groups, such as the turtledoves, *Streptopelia*, and wood doves, *Turtur* (Peters, 1937), and the fruit doves, *Ptlinopus* (Cain, 1954).

COLUMBINA

I think that the genera *Eupelia, Columbigallina* and *Oxypelia* are all best included in *Columbina*. In both its coloration and color-

pattern *"Eupelia" cruziana* is obviously intermediate between *Columbina picui* and the species currently placed in *Columbigallina*. The somewhat longer tail of *picui* and the proportionately larger feet and bill of *cruziana* should not, in my opinion, be rated higher than specific characters. *"Oxypelia" cyanopis* shows a resemblance to the *Claravis* species in having an attenuated first primary. It also has more rufous in its plumage and, unlike other species which I place in *Columbina*, has this rufous color on its head as well as elsewhere. I do not, however, think that these characters should be considered as more than specific.

CLARAVIS

The genus *Claravis* (formerly *Peristera*) was separated by Salvadori (1893) from the *Columbina* species because of its sharply attenuated first primary. I do not think this feature by itself is of generic value, since it often occurs in species that are, in all other respects, obviously congeneric with related forms that lack it. In doves it seems correlated with life in rather dense cover and may be an adaptation for rapid maneuverability. The *Claravis* species also differ in being larger and showing much greater sexual dimorphism, the males being predominantly bluish grey, the females brown. Taken together these differences seem to me just sufficient to justify retention of the genus for the three species *pretiosa, mondetoura* and *godefrida*, of which the two latter should, I think, be considered as forming a superspecies.

METRIOPELIA

Metriopelia melanoptera and *"Leptophaps" aymara* have, in addition to the features pointed out by Salvadori (1893), more pointed wings with proportionately longer primaries and shorter secondaries than have the *Columbina* species. *M. melanoptera* also differs in its larger size and lack of display markings on the wings, but it agrees more closely with the *Columbina* group in its general color-pattern than it does with *Zenaida asiatica*, to which it bears considerable superficial resemblance. To some extent *aymara* bridges the gap between *melanoptera* and the *Columbina* species, since in size and in its wing markings it is very close to *picui* and *cruziana* although in other respects nearer to *melanoptera*.

"Gymnopelia" morenoi and *ceciliae* were placed by Salvadori (1893) in his subfamily Geopeliinae. On the characters he gives for this, however, the only one that would justify even their generic separation from *Metriopelia melanoptera* is their more rounded wings, since *melanoptera* has similar, though less pronounced, scutellation of the

tarsus. *"G." ceciliae* and *"L." aymara* both have short tails and very long upper tail-coverts, while *"G." morenoi* and *M. melanoptera* are strikingly alike in coloration, although in other characters *morenoi* and *ceciliae* most closely resemble each other. All four seem to represent offshoots from *Columbina* stock which have become adapted for life at high altitudes and have, *aymara* excepted, lost the display plumage on the wings. *Ceciliae, morenoi* and *melanoptera* all have, however, extensive areas of bright yellow or orange orbital skin, which contrasts with the iris color (blue, green or brown) and probably "compensates" for lack of display plumage in hostile and sexual intraspecific encounters. Distinct as each of these four species is, I think Peters was right to emphasize their relationship and similarities by putting them all into the one genus *Metriopelia.*

UROPELIA

Uropelia campestris agrees with some of the *Columbina* species in its general size and coloration but has a longer tail and very rounded wings. Its wing markings very much resemble those of the *Claravis* species, from which, however, it differs in its much smaller size, short rounded wings and long pointed tail. I think it is sufficiently distinct to justify its retention in the monotypic genus *Uropelia.* The only reasonable alternative would be to place all the species here dealt with in *Columbina,* giving *Metriopelia, Claravis* and *Uropelia* only subgeneric rank. The difficulties of defining such a morphologically heterogeneous group would seem to outweigh the advantages gained by more sharply emphasizing the close phylogenetic relationship of all these forms.

SCARDAFELLA

The genus *Scardafella,* comprising the South American Scaled Dove, *squammata,* and the Middle American Inca Dove, *inca,* considered by Hellmayr and Conover (1942) to be representatives of a single species *squammata* (but *contra,* A.O.U. Check-list, 1957: 265), was placed by Salvadori (*sub nom. S. squamosa* and *S. inca*) in his subfamily Geopeliinae. *Scardafella* has a striking superficial resemblance to the Old World *Geopelia humeralis* and *G. striata,* but its closest affinities are undoubtedly with the other American ground doves. Peters (1937: 103–104) placed it between *Metriopelia* and *Uropelia.* Though having a much longer tail, *Scardafella* is quite close to *Columbina passerina* in its colors and color pattern, differing principally in having dark edges to most of its covert feathers, instead of only a slight indication of such markings on crown and neck as in *passerina,* and in lacking the iridescent wing markings. *Columbina*

picui approaches *Scardafella* in its rather long tail and, like the South American *Scardafella squammata*, has a white wing-patch. In the color pattern of its tail *Scardafella* is close to *Metriopelia ceciliae*, which also has a considerable amount of white in the wing. Mr. E. Eisenmann informs me *(in litt.)* that in the field *Scardafella inca* shows a general resemblance to *C. passerina* and *C. talpacoti* in habits and appearance. Mr. R. F. Johnston of New Mexico State College is, I understand, at present engaged on a detailed study of *Scardafella*, the results of which will, no doubt, produce decisive evidence of its affinities. Provisionally it seems justifiable to retain the genus because of its longer tail and lack of the iridescent wing markings.

SUMMARY

It is proposed that the ten genera of American ground doves recognized by Hellmayr and Conover (seven recognized by Peters) be reduced to five, with *Columbigallina, Eupelia* and *Oxypelia* merged in *Columbina*, and *Leptophaps* and *Gymnopelia* merged in *Metriopelia*.

All the American ground doves are more closely allied to each other than to any Old World genus.

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APPENDIX

GENERA (WITH THEIR COMPONENT SPECIES) OF AMERICAN GROUND DOVES RECOGNIZED BY SALVADORI (1893), PETERS (1937), HELLMAYR AND CONOVER (1942), AND PROPOSED REVISION

*Salvadori 1893**	*Peters 1937*	*Hellmayr and Conover 1942*	*Proposed revision*
Columbula	*Columbina*	*Columbina*	*Columbina*
picui	*picui*	*picui*	*picui*
Chamaepelia	*Columbigallina*	*Columbigallina*	*passerina*
passerina	*passerina*	*passerina*	*talpacoti*
talpacoti	*talpacoti*	*talpacoti*	*minuta*
minuta	*minuta*	*minuta*	*buckleyi*
buckleyi	*buckleyi*	*buckleyi*	*cruziana*
cruziana	*cruziana*	*Eupelia*	*cyanopis*
Oxypelia	*Oxypelia*	*cruziana*	*Claravis*
cyanopis	*cyanopis*	*Oxypelia*	*pretiosa*
Peristera	*Claravis*	*cyanopis*	*mondetoura*
pretiosa	*pretiosa*	*Claravis*	*godefrida*
mondetoura	*mondetoura*	*pretiosa*	*Metriopelia*
godefrida	*godefrida*	*mondetoura*	*aymara*
Metriopelia	*Metriopelia*	*godefrida*	*melanoptera*
aymara	*aymara*	*Leptophaps*	*morenoi*
melanoptera	*melanoptera*	*aymara*	*ceciliae*
Gymnopelia	*morenoi*	*Metriopelia*	*Uropelia*
morenoi	*ceciliae*	*melanoptera*	*campestris*
ceciliae	*Uropelia*	*Gymnopelia*	*Scardafella*
Uropelia	*campestris*	*morenoi*	*squammata*
campestris	*Scardafella*	*ceciliae*	*inca*
Scardafella	*squammata*	*Uropelia*	
squammata	*inca*	*campestris*	
inca		*Scardafella*	
		squammata	
		(includes *inca*)	

* For comparison, the specific names given are the current ones; Salvadori in some cases used different names, and treated as species several forms currently regarded as subspecies.

Birds of Martha's Vineyard. Ludlow Griscom and Guy Emerson. 1959. 164 pp., map. Price, $4.50. Privately printed. Available from Massachusetts Audubon Society, Boston 16, Mass., National Audubon Society, New York 28, N. Y., and Avery's, Martha's Vineyard, Mass.—Martha's Vineyard, a small island off the southern coast of Massachusetts, is ornithologically famous as the last haunt of the now extinct Heath Hen. After short introductory sections, including a nostalgic account of the "background of birding" on this island, the book consists chiefly of an annotated list of the 342 species recorded. Both the systematic list and the bibliography were revised by Mrs. Ruth Emery.—E. EISENMANN.

GENERAL NOTES

Recent Specimens from Southern New York and New Jersey Affecting A.O.U. Check-list Status.—The distributional status of the following species as given in the A.O.U. Check-list (1957) is substantially modified by specimens and data here reported. Unless otherwise stated the specimens mentioned were collected by the writer and are on deposit in the American Museum of Natural History in New York. Measurements are in millimeters.

Erolia ferruginea. Curlew Sandpiper. A first-year bird (not sexed) was taken from a flock of Dunlins *(Erolia alpina)* at Jamaica Bay, Nassau County, Long Island, New York, on October 12, 1956. The A.O.U. Check-list reports the Curlew Sandpiper as merely "casual" in North America. Actually, the species is of regular occurrence on Long Island in small numbers, at least in spring (Bull, 1958: 20). From 1947 to 1956 (when dredging destroyed the site) one to three individuals could be seen annually between May 10 and May 30 at the Pennsylvania Avenue mudflats on Jamaica Bay in Brooklyn, New York (see Sedwitz, 1950). Autumn records have been few, perhaps because in fall plumage Curlew Sandpipers are overlooked among the numerous Dunlins; however, in recent years there have been several late summer or autumn reports of one or two individuals from Jamaica Bay, in or near New York City. The bird here recorded (identity confirmed by Dr. K. C. Parkes) is the only recently collected specimen from the area, but among the older examples is one taken on the remarkable date of December 29, 1923 (Cruickshank, 1942: 202).

Thalasseus sandvicensis acuflavidus. Sandwich (Cabot's) Tern. The first New York State specimen of this species was collected on June 30, 1957 at Mecox Bay, Suffolk County, Long Island, New York, from a flock of Common and Roseate Terns *(Sterna hirundo* and *S. dougallii).* The A.O.U. Check-list gives the range of this form as breeding north to North Carolina, wandering to Virginia, with one accidental record from Ontario, Canada. Two old specimens from Massachusetts (not mentioned in the A.O.U. Check-list) are recorded by Griscom and Snyder (1954: 136). There were also sight reports from Massachusetts and New Jersey after the September, 1954 hurricanes (see Griscom *et al.,* 1955: 9, 16). The specimen under consideration was secured the day after Hurricane Audrey passed up the Mississippi Valley, with its peripheral winds buffeting Long Island at speeds up to 60 mph. A female in non-breeding plumage with molting primaries, the Long Island bird measured: ovary 18 x 6, wing (flat, outer primaries not fully grown) 255.5, tail 114, tarsus 22.5, culmen 50.5 The bill was black with the terminal 6 mm. silvery-yellow; legs and feet olive-black; irides black. Compared with *T. s. sandvicensis* of Europe, it showed the limited white edgings on the primaries characteristic of the American *acuflavidus.* The measurements also placed it in that form. The identification was confirmed by Dr. R. C. Murphy.

Pipilo erythrophthalmus arcticus. Rufous-sided (Spotted) Towhee.—An immature female of the western *maculatus* group of towhees (formerly considered a separate species) was collected for the first time in New York on February 16, 1957, at Jones Beach, Nassau County, Long Island. It had been present since at least December 28, 1956, when it was discovered and identified as a Spotted Towhee by Robert H. Grant. No record from the eastern states of *arcticus,* or of any member of the spotted-backed races, is mentioned by the A.O.U. Check-list, except for one specimen listed as *P. e. montanus,* from Metuchen, Middlesex County, New Jersey, based on a female taken December 24, 1952 (Baird, 1957). For reasons stated below, that

specimen should also be assigned to *arcticus*. According to the Check-list, *arcticus* breeds in the northwestern Great Plains and northeastern Rockies from Alberta and Saskatchewan to central northern Nebraska, and winters from Colorado and Kansas to Texas, casually east to Iowa and Illinois, while *montanus* breeds in the western and southern Rocky Mountains from central eastern Nevada and California to Arizona and northwestern Mexico, and winters from southern Utah to central Texas, casually to Nebraska and Kansas. Swarth, the original describer of *montanus*, and of the Great Basin race *curtatus*, states (1913: 173–4) that females of *montanus* and *curtatus* have the head and upper parts "very dark (a dull slate color) with little or no indication of brown. In the female of *arcticus* these same areas are so overlaid with a brownish suffusion as to give a decidedly different and lighter tone of color to the whole bird" (see also, Swarth 1905: 173–4). Through the courtesy of Dr. John Aldrich of the United States National Museum, the 1952 New Jersey specimen was compared with the Long Island bird and with a series of *arcticus*, *montanus* and *curtatus* in the American Museum (other races could be eliminated immediately). Both eastern specimens are very similar and, in their lighter grayish head, distinctly suffused with brownish, agree with *arcticus*, and differ considerably from the much darker and more slaty-headed *montanus* and *curtatus*. Dr. Charles G. Sibley, of Cornell University, to whom the Long Island and New Jersey specimens were sent, confirmed the identification of both as *arcticus*. The Long Island bird (now in the Museum of the State of New York at Albany, N. Y.) had the skull not completely ossified and measured: wing (flat) 80.5, tail 88, tarsus 28.5, hind toe and claw 19.5, culmen 13, and length of white spot on outermost rectrix 29.5. On December 23, 1958 the writer collected a second New York specimen of the *maculatus* group in Bronx Park, New York City. This bird had been first found and identified by T. Peszell on November 30, 1958. Like the Long Island specimen, it was a first-year female with the skull not completely ossified, and the following measurements: wing (flat) 80.5, tail 90, tarsus 27, hind toe and claw 17.5, exposed culmen 12.7, and white spot on outermost rectrix 31.5. This individual differed somewhat from the Long Island specimen in having the head and back rather more tinged with brownish, though still of a distinctly grayish tone. The wing-coverts, scapulars, and interscapulars were spotted or streaked with white or whitish, the pale streaks of the interscapulars being suffused with fulvous. Dr. Charles Sibley and Mr. David West, to whom the specimen was sent, confirmed that this was a member of the *maculatus* group, but were unwilling to make a subspecific identification on the comparative material available at Cornell University. On the basis of the series in the American Museum, and the literature, I believe this bird also to be *arcticus* and Mr. Eugene Eisenmann concurs in this identification. The collection of three examples of western towhees in localities in or near the City of New York within the past few years suggests that these birds may be reaching the coast more regularly than formerly, or that they have been overlooked. The likelihood of oversight is indicated by the fact that all three were first seen either on a Christmas Count or on a pre-Count survey.

Junco oreganus montanus. Oregon Junco. A male, now in the American Museum, the first recorded specimen of this species from New Jersey, was taken on February 23, 1958 at East Orange, Essex County. It was first identified on January 24, 1958 and was seen almost daily (usually several times a day) at the feeding station of Mrs. Anne W. Wachenfeld, with whose kind permission it was taken. It measured: wing (flat) 77.5, tail 64, tarsus 22, culmen 10.5. Mr. Eisen-

mann allocated the specimen to the northern population of the subspecies *montanus*, as defined by A. H. Miller (1941: 251–264) and the 1957 A.O.U. Check-list, a race which breeds chiefly in the northern and western Rockies. Confirmation was received from Dr. Miller,who *(in litt.)* considered it somewhat atypical, although clearly within the *montanus* group, and probably "one of the more northerly and western representatives of the race *montanus*, which are not as gray-backed as the southern division of that race." The Check-list characterizes the Oregon Junco as "casual" on the Atlantic slope and records only one specimen east of the Alleghenies between Massachausetts and Maryland—Poundridge Township, Westchester County, southeastern New York, a dark-headed male (wing [flat] 80, tail 69) in the American Museum, taken by F. C. Scott on December 6, 1946, found by Dr. Miller *(in litt.)* to be "quite typical" of *montanus*. In recent years, there have been sight reports of Oregon Juncos almost annually from the suburbs of New York City, occasionally near coastal beaches, but most frequently at inland feeding stations, particularly in northern New Jersey. In this respect these juncos differ from most other western wanderers, which are usually found along the coast.

Spizella pallida. Clay-colored Sparrow. An immature (sex?) was taken from a flock of Savannah Sparrows *(Passerculus sandwichensis)* near Jacob Riis Park, Queens County, Long Island, New York, on October 12, 1956. This appears to be the first specimen reported for the Atlantic coast of New York. According to the A.O.U. Check-list, the Clay-colored Sparrow occurs in the east only as "casual in . . . Ohio (Ottawa County), New York (Ithaca), Massachusetts (Lenox, North Andover)." During the past ten years, this midwestern species has come to be of regular occurrence in small numbers in autumn on the south shore of Long Island, New York, and on the coast of New Jersey (Bull, 1958). Most observations on Long Island are in late September and early October, but dates range from September 2 to November 11. In recent years at least one has been reported each fall by experienced observers and some seasons have produced twelve or more reports. As many as three individuals have been noted in one day at Riis Park. The species is most frequently reported from Jones Beach State Park, Gilgo State Park (Alperin and Eisenmann, 1950) and Riis Park, all on the barrier beaches of the south shore of Long Island, where it favors short grasses near open patches of sand. It has been reported at least twice as far east as Montauk Point. There are a number of fall reports from the barrier beaches of central and southern New Jersey. The first New Jersey specimen was taken on September 12, 1953 (Fables, 1955: 71). In addition Joseph R. Jehl, Jr. has collected the following recent specimens: September 14, 1957, Stone Harbor, Cape May County; September 28, 1957, Tuckerton, Ocean County; and September 14, 1958, Island Beach, Ocean County. Other individuals have been banded, photographed, and released. The Long Island and the two 1957 New Jersey specimens are in the American Museum of Natural History and the 1958 New Jersey bird is in the Newark Museum. Their identifications were confirmed by Dr. Parkes and Mr. Eisenmann.

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—P. A. BUCKLEY, *6024 Fieldston Road, Riverdale 71, New York, N. Y.*

Albinism in *Podiceps grisegena* and other grebes.—During field work in the Delta Marsh in southern Manitoba, two juvenile albino Red-necked Grebes (*Podiceps grisegena holböllii*) were seen with a normal colored adult during July, 1954. One of the juveniles was collected by M. C. Milonski and the writer on July 15 and was found to be an incomplete albino. Its irises were brown and the bill and feet were yellow, though the plumage lacked any coloration. The bird was nearly full grown, with the body plumage complete and primaries breaking from their sheaths. The specimen is now in the museum of the Delta Waterfowl Research Station.

Albinism in grebes has been considered rare, but this rarity may reflect the inconspicuous behavior of grebes on relatively isolated areas, not merely the low incidence of such aberrations. Observations of albinism have accumulated in recent years and at least six species and three genera are now represented. Both partial and incomplete albinism have been reported, but there is only one uncertain case of complete albinism and apparently no record of imperfect albinism. Terminology is modified from Mueller and Hutt (J. Hered., **32**: 71–80, 1941). "Complete" is used here in place of "total" for a bird lacking melanin in the eyes and skin, as well as in the plumage. This term is consistent with "incomplete" (lack of melanin in plumage, eyes or skin, but not all three), and with the original terminology proposed by Pearson, Nettleship, and Usher (Draper's Co. Research Memoirs, Nos. 6, 8, and 9, 1911–1913). "Total" may be used for animals lacking all pigments.

In Europe, partial albinism was reported in the Horned Grebe (*P. auritus*) by Petit (Bull. Soc. Zoo. France, **34**: 32–35, 1909), in the Eared Grebe (*P. caspicus*) by Chernel de Chernelhoza (Ornis, **14**: 524–527, 1907), in the Great-crested Grebe (*P. cristatus*) by Gloger (J.f. Orn., **14**: 285–286, 1866) and Chernel de Chernelhoza (*op. cit.*), and in the Red-necked Grebe (*P. g. grisegena*) by Sage (Bull. Brit. Orn. Club, **76**: 109, 1956). In North America, the U. S. National Museum contains a partial albino Eared Grebe and there is a partial albino Horned Grebe in the collection of the Denver Museum of Natural History. Incomplete albinism was reported in the Red-necked Grebe (*P. g. grisegena*) by Chernel de Chernelhoza (*op. cit.*) and in the Great-crested Grebe by Grochmalicki (Kosmos, Lemberg, No. **50**: 892–894, 1925). A Western Grebe (*Aechmophorus occidentalis*) in the Manitoba Museum of Natural History appears to be the only specimen of a complete albino. This bird was killed by a hunter and was reported to have had pink eyes and cream-yellow bill and feet.

Sight observations of "white" grebes—presumably incomplete or complete albinos—have been reported by several authors. Stott (Condor, **50**: 46, 1948) observed a white Eared Grebe in California and Rockwell (Condor, **12**: 188–193, 1910) observed a white Pied-billed Grebe (*Podilymbus podiceps*) in Colorado. Because of their individuality, some of these albinos have provided interesting information. Schuz (Der Vogelzug, **2**: 40–41, 1931) assumed that two white Great-crested Grebes observed in two areas in Europe at different times were the same bird and estimated the speed and route of migration of this individual. Observations of a white Eared Grebe by Allen (Condor, **42**: 127, 1940) suggested that wintering populations in California were stable from at least October until February.

For their kindness in searching grebe collections for albinos, I am indebted to personnel of the above mentioned museums and to those of the following museums: American Museum of Natural History, Carnegie Museum, Chicago Natural History Museum, Cornell University Laboratory of Ornithology, Harvard University, Los Angeles County Museum, Minnesota Museum of Natural History, New York State Museum, Saskatchewan Museum of Natural History, State University of Iowa, University of California at Berkeley, University of California at Los Angeles, University of Michigan Museum of Zoology, and Yale University.—MILTON W. WELLER, *Iowa State College, Department of Zoology and Entomology, Ames, Iowa.*

Eared Grebe in South Carolina.—On January 13, 1959, while looking at two Horned Grebes (*Podiceps auritus*) in the Charleston Municipal Yacht Basin, Charleston, South Carolina, my wife and I noticed a different looking grebe pop to the surface of the muddy water nearby. It proved to be an Eared Grebe (*Podiceps caspicus*)—the first record for the state of South Carolina.

At my suggestion, Milby Burton of the Charleston Museum collected it on the following day. The bird (Charleston Museum No. 59.8), a female in winter plumage, weighed a fraction over 11 ounces. The stomach contents consisted of small fish and tiny shrimp. Measurements in mm. are: wing 124.5; tarsus 39.5; culmen, slightly depressed in center, 23.

The five inner primaries are narrowly tipped with white, the amount of white tipping increasing from 1.5 to about 8 mm. on the innermost of the eleven primaries. This tipping and the lack of reddish tinge in the primaries indicate an immature of the American race, *californicus*, rather than the nominate European race, which has the innermost primaries largely white, at least on the inner webs (Baird, Brewer and Ridgway, "Water Birds of North America", vol. 2, pp. 435–436, 1884; Witherby *et al.*, "Handbook of British Birds", vol. 4, p. 105, 1940). E. B. Chamberlain, who prepared the skin and confirmed the identification, records: "iris orange, with a fine white inner ring".—WALTER DAWN, *176 Wentworth Street, Charleston, S. C.*

Records of Flight Preening and Related Aerial Activities in Birds, Particularly the Black Tern.—Although plumage maintenance activities in most birds are performed only while perching, standing, swimming, or while on the nest, certain groups carry on these activities to a varying degree while in flight. One would expect such behavior to appear in those groups that have evolved a high degree of mastery in the air and, indeed, the existing records indicate that this is the case.

Shaking of the plumage is probably the most common and widespread of these movements. It may be seen directly following any activity which is apt to

displace the feathers, *e.g.*, fighting, bathing, diving into the water, or copulating. Because it is a rapid movement and does not necessitate more than an instantaneous departure from normal flight activity, it is not necessarily restricted to those birds with unusual flight ability. I have observed it during flight in a variety of species, especially after bathing and following banding operations.

Scratching of the head and neck in flight may be more widespread, and is certainly more frequent, than records indicate. It has been reported in the following species: Light-mantled Sooty Albatross (*Phoebetria palpebrata*) (Murphy, 1936: 499), Wandering Albatross (*Diomedea exulans*) and Royal Albatross (*Diomedea epomophora*) (W. C. Dilger, pers. comm.), Western Gull (*Larus occidentalis*) (Bent, 1921: 97), Glaucous-winged Gull (*Larus glaucescens*) (Bent, 1921: 71), Sooty Tern (*Sterna fuscata*) (Chapman, 1908: 197).

I have seen aerial scratching in the Mallard (*Anas platyrhynchos*), Herring Gull (*Larus argentatus*), Ring-billed Gull (*Larus delawarensis*) and Black Tern (*Chlidonias niger*) and in all cases it was accomplished in the same manner. While gliding, the head was lowered and turned to the side while the foot was brought forward beneath the wing. The average duration of the movement in the Black Tern is five seconds, during which time the head may be turned so that successive areas of the head and neck are treated.

Chapman's statement (1908: 197) that in the Sooty Tern "it was a common sight to see one put its foot through its inner wing-feathers and scratch its ear" might be interpreted as "over-the-wing" scratching. If this is the case, it is an exceptional method of scratching in the Laridae.

My Mallard record is based on a single observation and occurred as the bird was gliding in for a landing. After landing, it ran around excitedly, stopping frequently to scratch. This is probably a case where an unusually strong stimulus caused a response in a species that does not commonly scratch in the air. Although the movement seemed quite effortless, the bird plummeted earthward and made a rather awkward landing in spite of considerable braking.

The most highly developed activity of this type is probably flight preening. Murphy (1936: 499) writes that a Light-mantled Sooty Albatross "was seen to turn down its head and preen the feathers of its belly without losing its place in the squad". Bent (1921: 97) in describing the behavior of the Western Gull states that it occasionally preens the breast feathers while soaring. I have observed flight preening in two species besides the Black Tern—the Purple Martin (*Progne subis*) and the Bank Swallow (*Riparia riparia*). The swallow records were single observations; the activity in both species was of short duration (4 to 6 seconds) and involved the feathers of the upper breast.

During the summers of 1952 through 1958, observations on the behavior of the Black Tern were made at the colony on North Pond in Oswego County, New York. Flight preening was found to be a fairly common and a beautifully coordinated activity in this species. It can be seen at any time of day throughout the breeding season, but it seems to be particularly common during late afternoon and evening. The characteristic undulatory flight of a preening bird can be recognized at a considerable distance. The bird flies to a peak then preens while gliding to a low point. Here, it stops preening and flies to another peak, and so on. The duration of the flights which I have observed ranged from three or four seconds (a single glide) to twelve minutes. During long flights, the bird circles widely over the marsh maintaining a constant altitude, except of course, for the relatively short amplitude of the undulations (two to four feet) caused by the

alternate flapping and gliding components. The stereotyped pattern of a flight may be interrupted by short periods of slow, flapping flight. When possible, a bird will use air currents to advantage, thereby allowing an extended period of gliding with a minimum loss of altitude.

Short preening bouts involving the feathers of the neck and breast are the most common, while longer flights during which the inner wing coverts, scapulars and feathers of the back are also preened, are less frequent. On several occasions I have observed preening of the inner secondaries and tertials, and rubbing of the side of the head on the humerus.

At a distance, the attitudes assumed by birds performing these aerial activities might possibly lead an observer to the false impression that they are some form of sexual or hostile display. The actual preening movements are usually so subtle that they cannot be seen unless the bird is fairly close to the observer. Most flight preening seems "autocthonous", *i.e.*, activated by preening motivation (see Moynihan, 1955: 240), and in no cases that I have seen does it appear to have become ritualized. It is somewhat mimetic, *i.e.*, a preening bird tends to release preening behavior in other birds in the immediate vicinity (see Armstrong, 1951: 46), but it is not as strongly so as regular terrestrial preening.

On many occasions I have observed short preening glides in situations where one might expect displacement activities (see Moynihan, 1955: 241) to occur in the Black Tern, *e.g.*, both preceding and following the change-over at the nest, following a social attack on a predator, and during the period of general excitement in a colony which precedes the "high flight" (see Baggerman *et al.*, 1956: 9). It is common to see a male make abrupt preening movements of the neck, breast or scapulars as he circles above the nest prior to landing and relieving the female of incubating or brooding duties. I am convinced of the "allocthonous" nature of the preening in this case, *i.e.*, the preening is a displacement activity probably caused by the thwarting of the strong incubation or brooding drives of the male by the presence of the female on the nest and her usual reluctance to leave it. (See van Iersel and Bol, 1958: 55 *ff.*, for a possible alternative explanation of displacement).

It would be very interesting to know if flight preening reaches this level of development in any other species. I have spent much time observing the aerial behavior of the Common Tern (*Sterna hirundo*), but have never seen flight preening of any sort. I believe that if it does occur in this species, it must be rare.

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Breeding of the Least Bittern in Manitoba.—*Ixobrychus exilis exilis* has been considered of merely casual occurrence in Manitoba. Thompson (1891) listed the bird as an "accidental visitant". Seton (1909), Bent (1926), and the A.O.U. Check-list (1957) mention a few records. East of Manitoba it has been reported as common in the southern marshes of Ontario, becoming less abundant in more northerly regions around Lake Nipissing and Sault Ste. Marie (Snyder, 1951). Roberts (1932) noted that it was abundant at Heron Lake in Jackson County, Minnesota, and from there northward, where conditions were favorable, through the Red River Valley to Manitoba. Forbush (1925) regarded it as a possible breeder in the Province. The A.O.U. Check-list of North American Birds (1957) listed Canadian breeding of the Least Bittern only in southern Ontario and St. John County, New Brunswick, and stated that it "wanders casually" to Manitoba.

Records of Least Bitterns have become more frequent in recent years, particularly in the extensive reed-grass (*Phragmites communis*) marshes along the southern shores of Lake Manitoba. Information on all unpublished records known to me from southern Manitoba through the summer of 1958 is presented in the table. As of this writing, two nests have been found in the Delta Marshes. The first nest was located June 8, 1949 by Peter Ward of the Delta Waterfowl Research Station. It was subsequently observed and photographed by Richard Sutton, Director of the Manitoba Museum, and H. V. Hosford. This nest contained four eggs. One was collected for the Manitoba Museum and the other three placed in an incubator at the Delta hatchery. They did not hatch, but they had been incubated prior to removal from the nest, thus indicating a full clutch. The second nest was discovered June 13, 1956 by D. P. Olson and myself. It contained six eggs, two of which were collected for the Delta Station. These were fresh, but they also were likely part of a complete clutch.

Although separated by approximately 8½ miles of marsh, the two nests were in nearly identical ecological situations. Both were located in dense reed-grass along slow-moving creeks. The nests were slightly elevated above water level and consisted of flimsy platforms of dead stems wedged among standing stalks. The eggs were scarcely contained within the shallow bowls.

I am grateful to the following Manitoba residents for information on records in the Province: O. P. Gibson, A. G. Lawrence, Harold Mossop, A. H. Shortt and Richard Sutton, all of Winnipeg; H. A. Hochbaum, D. F. McKinney and Peter Ward, Delta Waterfowl Research Station, Delta; Herman Battersby and David Hatch, Oak Lake; and Frank Robb, Brandon.

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TABLE

RECORDS OF THE LEAST BITTERN IN MANITOBA

Date	*Authority*	*Remarks*
ca. 1918	Battersby (*fide* Hatch)	one seen along Assiniboine River north of Oak Lake
Oct. 12, 1923	Smith (*fide* Lawrence) spec. in B. J. Hales Natural History Museum, Brandon	adult male found injured in Portage la Prairie
June 23, 1924	Broley (*fide* Lawrence)	one seen at a lake near Niverville
May 15, 1933	Pollock (*fide* Lawrence)	one seen near Winnipeg
Aug. 20, 1936	Chagnon (*fide* Lawrence) spec. placed in coll. of Rev. Chagnon.	one caught in trap on Sandy Bay Indian Reservation, Amaranth
June 22, 1939	Hochbaum	one seen at The Gap, Delta Marsh
June 8, 1949	Ward and Sutton	nest with 4 eggs near The Channel, Delta Village
May 17, 1955	McKinney	one seen in Cadham Bay area, Delta Marsh
May 14, 1956	Hamilton and Hays (*fide* McKinney)	one seen in Delta Marsh
June 7, 1956	Dillon and Olson	12 seen along one mile of creek channel, Clandeboye Bay area, Delta Marsh
June 13, 1956	Dillon and Olson	nest with 6 eggs along above creek channel
June 20, 1956	McKinney	one seen at The Channel, Delta Village
Aug. 1956	Gibson	one seen on three occasions in Lake Francis Marshes, Lake Manitoba
Summer, 1956	Ward	at least three (one definitely young) brought to Delta Station, having been killed by cars along road south of Delta
June 14, 1957	Gibson	one seen on Lake Francis Marshes
June-July, 1957	Hochbaum	one seen on several occasions along road south of Delta
Summer, 1957	Ward	several sightings east of Delta Station
Spring, 1958	Ward	one seen east of Delta Station
June-July, 1958	Hochbaum	one seen on several occasions along road south of Delta

***Elanus leucurus* breeding in Surinam.**—The South American race of the White-tailed Kite *(E. l. leucurus)* according to Hellmayr and Conover ('Catalogue of Birds of the Americas'. Field Mus. Nat. Hist., Zool. Ser. 13, pt. 1, No. 4: 18, 1949) has been found definitely breeding only in Argentina and Chile. "The scattered records from the northern parts of its range (Colombia, Rio Branco, the Guianas, Venezuela, and Trinidad)," say these authors, "probably refer to winter visitors from the south." My records from Surinam also pointed in that direction, as I saw one in December, one in March, four in April, one in May, four in June and four in July. I considered this species as only a migrant in Surinam (Ardea **24**: 328, 329, 1954; Haverschmidt, "List of the Birds of Surinam": 36, 1955) and I am still of opinion that probably most, if not all, the birds I observed in these months were migrants.

However, *Elanus leucurus* does breed in Surinam. A pair were observed on the sugar estate "Marienburg" (Commewijne District) by Mr. Renssen almost daily from the moment he came to live there in September 1958. The birds frequented a particular place wholly overgrown with thick shrubbery with a few scattered trees amidst open fields, which were at that time not under cultivation. In the last days of December the birds were present with three young on the wing, and a loosely built nest of sticks was found in one of the trees. On January 3, 1959 I accompanied Mr. Renssen to that place and on arrival we immediately spotted the three young birds sitting together on a branch in one of the trees. It was clear that the young were still dependent of their parents. Twice one of the two parents disappeared in the neighboring fields to return in a short time with prey (a small mammal) in its talons, and alit near the young, passing the prey to one of them, after much calling. A Gray Hawk, *Buteo nitidus*, which ventured to come near was dived at and chased away by one of the old birds. I collected one of the young *Elanus*, which now bears my field number 3694 in the Leiden Museum. Aside from this fledgling (weight, 265 gms.; wing, 278 mm.; tail, 135; not sufficiently grown for measurements to have taxonomic significance), my only Surinam specimen, a juv. ♂, Paramaribo, April 1, 1947 (now in Mus. Zool., Univ. Michigan), weighed 272 gms., and measured, according to Dr. H. Tordoff: wing (chord) 289, (arc) 293; bill (from cere) 17.5, to base 22.5; tail 167; tarsus 38. These measurements indicate the smaller southern race, *E. l. leucurus*.—F. HAVERSCHMIDT, *P.O. Box 644, Paramaribo, Surinam.*

Rufous Hummingbird feeding on Sap of English Walnut at Sapsucker Holes.—On July 13, 1958, four Rufous Hummingbirds, *Selasphorus rufus*, were observed feeding on the sap of the English walnut, *Juglans regia* L. The sap was exuding from holes made by the feeding activity of the Yellow-bellied (Red-naped) Sapsucker, *Sphyrapicus varius nuchalis*. This activity was observed in a clearing at the site of an abandoned sawmill, approximately two miles northeast of Golden and Silver Falls State Park, in the Coast Range mountains of western Oregon. A single English walnut was located at the edge of an old apple orchard, about 150 feet from a small mountain stream. When first observed, the sapsucker was feeding in the upper branches of the walnut. The trunk and main branches were practically girdled by the hundreds of holes which had been made by this species.

Two pairs of Rufous Hummingbirds were flying around the tree. Occasionally they darted down to within six inches of the sapsucker but made no attempt to molest the larger bird. As I approached the walnut the sapsucker became alarmed

and flew to a nearby apple tree. Immediately one of the hummingbirds flew to the spot vacated by the sapsucker and hovered over the limb, while inserting its long bill into one of the newly-made holes. Only once during the 20 minute period of observation did two birds feed in adjacent holes at the same time. Occasionally the birds would perch while feeding. They continued feeding even when I climbed the tree and approached to within two feet of them.

On visiting the same spot two hours later two of the hummingbirds were observed in the vicinity of the walnut but were not feeding. At this time a sapsucker was feeding in an adjacent apple tree. At no time were hummingbirds observed feeding on the sap of tree species other than the walnut.

The sap of trees is not commonly thought of as food for hummingbirds, and there is only occasional mention of this type of feeding activity in the literature. Barrows (Michigan Bird Life, p. 387. 1912. Mich. Agric. Coll.) mentions the occasional use of the sap flowing naturally from trees as food by the Ruby-throated Hummingbird, *Archilochus colubris*. Obviously hummingbirds can only utilize trees from which the sap is already flowing. Such food sources are rather rare. Bolles (cited *in* Bent, U.S. Natl. Mus. Bull., 176, p. 343. 1940) noted the Ruby-throated Hummingbird feeding at holes made by the Yellow-bellied Sapsucker. Grinnell and Storer (1924. Animal Life in the Yosemite, p. 354. Univ. Calif. Press) reported Anna's Hummingbird, *Calypte anna*, feeding on the sap of the 'golden oak' at the holes of the Yellow-bellied (Red-breasted) Sapsucker, *Sphyrapicus v. ruber*. Woodbury (Condor **40** (3): 125. 1938) observed the Rufous Hummingbird feeding from workings on willow trees of the sapsucker, *S. v. nuchalis*. Woodbury did not mention whether other food sources were generally available in the vicinity. In the present instance there were very few flowers present in the small clearing where the birds were observed, and none in the surrounding virgin Douglas Fir forest.—R. Wiegert, *Dept. of Zoology, University of Michigan, Ann Arbor, Michigan.*

Head-scratching and Wing-stretching of Woodpeckers.—The Heinroths state that most passerines scratch their heads "indirectly", or "hinterherum", by lowering one wing and passing the foot over it and that woodpeckers in general do the same unless wishing to clean a corner of the bill momentarily (Heinroth and Heinroth, Die Vögel Mitteleuropas, vol. 1, p 315. Berlin. 1924–26). My observations made on six species of American woodpeckers, however, showed that they all scratched "directly"; *i.e.*, without lowering the wing. I have watched this type of head-scratching, almost daily, among six hand-raised individuals in an aviary: male and female Yellow-shafted Flickers (*Colaptes auratus*), two female Red-bellied Woodpeckers (*Centurus carolinus*), a Yellow-bellied Sapsucker (*Sphyrapicus varius*) and a Pileated Woodpecker (*Dryocopus pileatus*). The head-scratching may be done by itself or in association with preening. In the latter case a woodpecker passes its bill over the oil-gland at the base of the tail, rubs a foot with its bill, then lowers the head to one side and scratches it, as if passing on the oil by means of the foot. I have also observed direct head-scratching in the field. These observations included the Red-cockaded Woodpecker (*Dendrocopos borealis*) on one, and Downy Woodpeckers (*Dendrocopos pubescens*) on repeated occasions. Thus species in five genera of woodpeckers scratch in a manner reported among relatively few other groups of birds (Simmons, Ibis, **99**: 178–181, 1957; but *cf.* Nice and Schantz, Auk, **76**: 339–342, 1959).

Among other supposed fixed behavior patterns of the class Aves is the leg-

wing stretch movement (Eibl-Eibesfeldt and Kramer, Quart. Rev. Biol., **33**: 181–211, 1958). Woodpeckers do this in an atypical manner. All of my captive individuals stretch one wing way down without any movement of either foot. One has to be in a favorable position to see this clearly. It is more difficult to observe in the field, but on one occasion I watched a Pileated Woodpecker do a wing stretch while both of its feet were clamped widely apart on a tree trunk. It remained in view during the extreme downward movement of the wing. Koenig has photographed a Bee-eater (*Merops apiaster*) wing-stretching in this manner (Nature Stories from the Vienna Woods. Crowell. New York. 1958).—LAWRENCE KILHAM, *7815 Aberdeen Road, Bethesda 14, Maryland.*

Ash-throated Flycatcher in Alabama.—S. W. Simon (Auk, **75**: 469, 1958) summarizes the records of the Ash-throated Flycatcher (*Myiarchus cinerascens*) east of the Mississippi River in the United States—seven specimens and two sight records are listed. To this growing list I would add a specimen I collected November 2, 1958 at Dauphin Island, Alabama. The specimen was identified at the Louisiana State University Museum of Natural History by Dr. Robert J. Newman as *Myiarchus cinerascens cinerascens*. The specimen is now No. 4645.1a in the Florida State University bird collection. This is the first record of the species in Alabama (Thomas A. Imhof, personal communication).—LOVETT E. WILLIAMS, JR., *Wildlife Research Unit, A.P.I., Auburn, Alabama.*

New Record of the Eastern Barn Swallow in Micronesia.—The Eastern Barn Swallow (*Hirundo rustica gutturalis*), which normally winters as far south as Australia, has been reported as a fall and winter migrant in western Micronesia by several observers. (Baker, Smithsonian Misc. Coll., **107**: 65, 1948) reported swallows of this Asiatic subspecies in the Palau Islands, Western Carolines, in September, 1945 and on Guam, Marianas Islands, in October. Strophlet (Auk, **63**: 535, 1946) saw birds on Guam in late October and November. Marshall (Condor, **51**: 221, 1949) reported immature Barn Swallows from Saipan, Tinian in the Marianas and from the Palaus between October and February. These birds are apparently regular winter visitors to the Marianas and Western Carolines. No observations of Barn Swallows in the central or eastern Caroline Island archipelago have been recorded.

On the Island of Moen, Truk Atoll (7° N. Lat., 152° E. Long.), in the eastern Carolines, some 560 nautical miles southeast of Guam and 1040 nautical miles east of Palau, eleven Barn Swallows were observed on December 30 and 31, 1957. The birds were seen perched on electric wires on the northwest tip of the island, and were noted catching insects in flight, in company with Caroline Swiftlets (*Collocalia inquieta rukensis*). They remained near a flat marshy area covered by heavy growth of *Phragmites karka*. A bird collected on January 1, 1958 proved to be a young male with much subcutaneous fat. Testes measured 3.5 mm. It is now #570101-0101 in the collection of the Pacific Island Central School. On December 11, 1958, six Swallows were again observed in the same area. The birds remained on Truk for about one week.—JOHN H. BRANDT, *Truk, East Caroline Islands.*

South American migrant swallows of the genus *Progne* in Panama and northern South America; with comments on their identification and molt.—More birds of the Temperate Zone of South America migrate across the Equator than has been supposed (*cf.* Zimmer, Auk, **55**: 405–410, 1938). This is true of the

swallows, and probably of the swifts. The Argentine race of the Brown-chested Martin, *Phaeoprogne tapera fusca*, has proved to be a regular and abundant migrant to Panama (Eisenmann, Auk, **72**: 427, 1955), and the Patagonian Blue-and-white Swallow, *Atticora (Pygochelidon) cyanoleuca patagonica*, taken repeatedly in Panama, has recently been recorded in Nicaragua (Howell, Condor, **57**: 188, 1955) and Mexico (Paynter and Alvarez del Toro, Condor, **59**: 268, 1957). The migratory southern subspecies of the Ashy-tailed Swift, *Chaetura andrei meridionalis*, has been collected in northern Colombia and Panama in August, the height of the Southern Hemisphere winter (Darlington, Bull. Mus. Comp. Zool., **72**: 392, 1931; Rogers, Auk, **56**: 82, 1939), and I suspect that other little known South American swifts recorded from Panama and southern Central America during this season (*e.g.*, the White-chinned Swift, *Cypseloides cryptus*) may prove to be migrants (*cf.* Beebe, Zoologica, **32**: 167, 1947). Northern records of two other southern hemisphere migrants, the Southern Martin, *Progne modesta elegans*, and the Gray-breasted Martin, *Progne chalybea domestica*, are here reported. In connection with their identification it was found that stage of molt was a useful clue in distinguishing trans-equatorial migrants from north and south.

Progne modesta elegans. A Southern Martin was taken by H. Wedel on July 14, 1931, on the Caribbean coast of eastern Panama (near the Colombian boundary) at Obaldía (= Puerto Obaldía), Lat. 8° 40′ N. The specimen (Univ. Mich. Mus. Zool. no. 97608), labelled "♀ o.n.e.", has a few fresh purple feathers on the breast, sides, and under tail-coverts, suggesting an immature male. Measurements: wing (flat), 134 mm.; tail, 71 mm. The bird is in the same plumage, and in the identical stage of wear and molt (with three old pairs of outer primaries and two of rectrices), as various immatures taken on July 15, 1929 at Tahuapunto, Rio Uaupés, Brazil, just north of the Equator (reported in Zimmer's review of the genus, Amer. Mus. Novit., no. 1725: 8, 1955)—hitherto the most northerly records of this migratory form.

The reported breeding range of *elegans* is western and central Argentina south to northeastern Patagonia and north to the highlands of eastern Bolivia. In Argentina the first birds apparently arrive towards the end of August, and most have left by the end of March (see Wetmore, U.S. Natl. Mus. Bull., **133**: 547, 1926; W. H. Partridge, *in litt.*). The full extent of the winter quarters remains uncertain, but there is a large series in the American Museum of Natural History taken in the western Amazon basin of Brazil and Peru between May 6 and September 1, 1929 (Zimmer, 1955, *loc. cit.*). Farther north wintering *elegans* may well have been overlooked because of resemblance to other species of *Progne*. The adult male, in its over-all steel blue color, is a counterpart of the North American Purple Martin, *P. subis*, which also winters chiefly in Brazil; other plumages, though quite distinctive, bear some likeness to those of both *subis* and the resident tropical *chalybea*. Both migrant *subis* and *elegans*, though arriving at opposite seasons, may well occur in the same tropical localities as transients or winter residents during March and April and from the end of July into September. Thus specimens of *P. s. subis* have been examined taken near Colón, Panama on the southward migration as early as August 3 and 5 (coll. by J. E. Ambrose, Jr.) and taken in Venezuela on August 28. Though the return migration has been observed in Panama by February (Wetmore, Smith. Misc. Coll., **139**, no. 2: 13, 1959), there are specimens of *subis* (in the American Museum) taken as late as April 1 and 2 in Brazil and April 4 and 18 in Venezuela.

Identification. Females and immature of *elegans* have dark sooty-brown underparts, the feathers with narrow pale brownish margins, often obsolescent on throat and breast, wider and more whitish on the lower abdomen. *Elegans* thus looks entirely dark below, relieved only by whitish "scaling". In corresponding plumages of both *subis* and *chalybea* the abdomen and under tail-coverts are normally white, more or less marked with dusky *streaks*, which are usually very fine shaft-streaks in *chalybea*, but are often broader in *subis*. Sometimes in *P. s. subis* the under tail coverts may be dusky, edged with white; and very exceptionally the underparts may so suffused with sooty-gray as to suggest the pattern of *elegans*, but with shaft-streaks still apparent and a gray patch on each side of the neck, which may meet in a narrow ring across the hind-neck. *Adult males* of *elegans* may be distinguished in the hand from *subis* by longer tail and deeper tail fork (25 mm. or more), and by lacking the small concealed white flank patch (while retaining the adjacent patch on the sides of the lower back). These points are hard to determine in molting birds, and during the periods when these two species may occur together they are likely to be molting. Fortunately *subis* and *elegans* begin and end the molt at opposite times of the year—in phase with their antipodal breeding seasons. Dated specimens can usually be distinguished readily by stage of wear and molt. In these highly migratory and aerial birds the molt of primaries is remarkably protracted (requiring probably five and possibly six months), and the contrast between worn brown remiges and glossy fresh ones is obvious in specimens. For example, in August and September adult *subis* has begun to molt, but is unlikely to have replaced more than two to four inner primaries, while adult *elegans* is likely to have completed (or almost completed) the wing molt. In March and April the opposite situation prevails. Birds of the year begin and end the primary molt a month or more later than older birds.

Progne chalybea domestica. To the larger migratory southern race of the Gray-breasted Martin, I would allocate three specimens in the American Museum (Nos. 433492, 435045, 435047)—the first to be reported north of the Equator. They were collected by the Olalla Bros. in 1929: a male at El Merey, Río Casiquiare, Venezuela (about 3° N. lat.), on April 18; and two females at Tahuapunto, Río Uaupés, Brazil, on July 15. Although *domestica* is said to leave its Argentine breeding grounds by March (gathering in flocks with *elegans*) and to begin to reappear in late August, the most northern record has hitherto been of seven taken in September, just south of the Equator, at Yucabí, upper Rio Negro, Brazil (Zimmer, 1955, *op. cit.*: 2), a locality where the same collector on the same date also took the breeding form, nominate *chalybea*. The three more northern specimens, here considered *domestica*, Zimmer (*op. cit.*) included under *chalybea*. He apparently was disinclined to attribute to the migrant form specimens found in the range of the tropical race, unless exceptionally large in both tail and wing.

The subspecies *domestica* breeds over northeastern Argentina, adjacent Paraguay and eastern Bolivia, north to central and southeastern Brazil, where it apparently intergrades with the smaller tropical *chalybea*. Based on a sample series from the undoubted breeding range of each, Zimmer (*op. cit.*: 1–2) found the following size differences. *P. c. chalybea:* males—wing, 124–138 (131.7), tail, 58–66 (62.5); females—wing, 121–132 (130), tail, 54–65 (61). *P. c. domestica:* males—wing, 137–144 (141.2), tail, 70–77 (73.2); females—wing, 135–142 (139), tail, 70–80 (74). In *domestica* adults tend to be paler on the throat and breast, and immatures to have more conspicuous pale edgings on the brown breast; but these characters sometimes appear in *chalybea*. The male from El Merey, Venezuela, though immature, agrees with the larger southern race, both in color and in measurements; wing,

141, tail, 70; in fact the label in Zimmer's handwriting identifies it as *domestica*. This bird (gonads marked small) shows molt just begun, having dropped the innermost primary—as one would expect in April of a southern migrant bird of the year. The listing as *chalybea* in Zimmer's paper may have resulted from confusion with another example (wing, 130; tail, 62) from the same locality, taken on the following day, undoubtedly nominate *chalybea*. That is an adult female labelled as having enlarged ovary (as might be expected in April of the popula' on breeding at 5° N. latitude), and has just completed the wing molt (the sheath of the outermost primary still visible). The two females from Tahuapunto, Brazil, show the mottled breast usual in young *domestica* and satisfy Zimmer's criteria in wing length (136, 140). Their short tails (64, 65) are explained by their being birds of the year in full molt, with the longest remiges and rectrices very worn (the tips broken off in one specimen), and with all except the two outer pairs of primaries and rectrices replaced. Zimmer's sample series of *domestica* from the breeding grounds consisted of adults. In *Progne* birds of the year have shorter tails. Thus, in the American Museum series of *elegans*, which is a longer-tailed form than *domestica*, several of the immatures, taken as migrants at Tahuapunto on the same date and place, have tails measuring only between 63–65. These birds are in a stage of molt and wear like that of the two *domestica*. While we do not know the molt regimen of such martins as may breed about Tahuapunto, this agreement of the two specimens with the admittedly migratory *elegans* suggests that they also are migrants.

K. H. Voous ("The Birds of Aruba, Curaçao, and Bonaire", p. 207, Martinus Nijhoff, The Hague, 1957) has pointed out that three out of four *Progne chalybea* taken in Curaçao (where this species does not breed) are pale-throated and may meet Zimmer's mensural criteria for *domestica*, but he tentatively preferred to list them as nominate *chalybea*, which breeds on the adjacent Venezuelan mainland. Dr. Voous has kindly advised me that only one of the Curaçao birds is in his possession, and his notes do not indicate that any was molting primaries or rectrices. The two largest birds (wing, 147.5, 145) were adults taken on October 6, 1955; that they should not be molting is what one would expect of *domestica*.

Relation of breeding and molt cycles in Progne: The information available on breeding season and the examination of over two hundred specimens of *P. chalybea*, ranging from Mexico to northern Argentina, indicate that in tropical latitudes north and south of the Equator breeding and molt occur at opposite times of the year, corresponding in general with the seasons of the adjacent temperate zone. In the more sedentary tropical populations of *P. chalybea* the breeding season may be longer than that of the northern *subis* or the southern *elegans*, and the molt of individual birds may possibly progress faster. For populations of *P. chalybea* very close to the Equator (two or three degrees) the molt and breeding relation is unclear, as few specimens bear significant gonadal data. At these low latitudes, as Miller has reported (Acta XI Cong. Int. Ornith. Basel 1954: 495–503, 1955), certain passerines have, and others have not, a definite breeding season, and even at higher tropical latitudes some passerines may molt while nesting—contrary to the usual situation in the temperate zones. Since reproduction and molt have different endocrine bases (Assenmacher, Alauda, 26: 251–265, 1958), a correlation adaptively useful in areas of marked seasonal change may conceivably be absent elsewhere, even in the same species. Thus on the Galapagos Archipelago, straddling the Equator, the sedentary endemic *P. m. modesta* (currently regarded as conspecific with the migratory *elegans*) breeds while actively molting. Beebe reported finding six nests in March on Indefatigable Island, just south of the

Equator ("Galapagos: World's End", p. 93. G. P. Putnam's Sons, 1924). Of 30 Galapagos specimens examined in the American Museum, all those (14) taken between late February (molt begun) and May (molt incomplete) were replacing primaries; seven March, 1935 specimens (with from four to six fresh or sprouting primaries) bear labels, in J. P. Chapin's handwriting, showing enlarged gonads, two with brood spot and enlarged oviduct (one with two empty ovarian follicles), indicating recent egg-laying. (October and November specimens from the Galapagos are not molting, except for an immature; none carry gonadal indication.) Molting when breeding has not been noted in *P. chalybea*, but the possibility that this may occur near the Equator must be kept in mind in using molt and gonadal condition as clues to subspecific identification.

In this paper *P. subis* has been used in the sense of the A.O.U. Check-list (1957), and not in the broader sense of the "Distributional Check-list of the Birds of Mexico," pt. 2: 107 (1957), because the West Indian *cryptoleuca* and *dominicensis* and the west Mexican *sinaloae* seem to me at least as closely allied to *P. chalybea* as to *P. subis* (see Zimmer, 1955, *op. cit.*: 2–4). Though all forms of *Progne* are geographical representatives, the likelihood of some breeding overlap in Mexico and Argentina justifies the present maintenance of several species (Zimmer, *loc. cit.*; Hellmayr, Field Mus. Nat. Hist., Zool. Ser., **13**, pt. 8: 21, 23–24, 1935). In treating *elegans* as a subspecies of *P. modesta* Hellmayr and Zimmer are followed, with some hesitation; the English name selected is intended for the entire *P. modesta* complex. I am indebted to Dr. R. S. Storer for sending the Panama specimen of *elegans* for identification.—E. Eisenmann, *American Museum of Natural History, New York 24, N. Y.*

Blue Jays Attack a Red Bat.—Although the Blue Jay's habit of pestering hawks and owls and of frequently attacking other birds is commonly observed, assaults on bats may be rare. The following incident may therefore be worth recording.

During the noon hour of July 3, 1958, Mr. R. L. Browning, a student, came to my office to inquire whether anyone in the Biology Department might be interested in an observation which he and his wife had just made. While sitting under a tree on the University of Louisville campus they had become aware of a commotion overhead which involved a small group of screaming Blue Jays, *Cyanocitta cristata*. A bat then flew from the tree, followed by the attacking jays, and came to earth a few yards away. At the approach of the Brownings the jays departed while the bat remained motionless on the ground.

The three of us then went immediately to the scene of the encounter, where we located a Red Bat, *Lasiurus borealis* (Müller), in the grass. When picked up it made no attempt to fly but it was able to bite. The only visible evidence of injury was a small abrasion on one side of the abdomen. By the following day it showed no signs of distress.—William M. Clay, *Department of Biology, University of Louisville, Louisville 8, Kentucky.*

Large Numbers of Bohemian Waxwings in New Mexico.—During the month of April, 1959, large numbers of Bohemian Waxwings *(Bombycilla garrulus)* were seen in Santa Fe, New Mexico by myself and other observers. The invasion of these birds began April 5 and lasted approximately one month. The last ones I saw were three on May 12. During the month at least 5,000, and possibly as many as 10,000, were present in the area. I saw hundreds in my garden on numerous occasions. As an indication of the great numbers of the birds, on April 13, a large

flock drank two and one half gallons of water from a container in my garden. It was a common happening to see limbs of trees bending under the weight of the birds, and to see them perched on television antennas. On April 30 and later, they were noted chasing one another through the tree-tops, perhaps evidence of courtship. Their principal food seemed to be the green seeds of Siberian elm, and the buds of cottonwoods. They also ate the buds from my cherry trees.

These large numbers were especially notable in view of the fact that up to this time there were only two published records of the occurrence in New Mexico (F. M. Bailey, 1928. Birds of New Mexico, pp. 591–592; and P. R. Snider *et al.*, Audubon Field Notes, **13**: 236, 1959), in which but 23 and 26 individuals were seen, respectively. I understand that during the winter of 1958–59 a great flight of Bohemian Waxwings occurred into many parts of the western United States where they are not usually seen.—JENS KNUDSEN JENSEN, *133 Mesa Verde Street, Santa Fe, New Mexico.*

Northern Birds from a Florida Indian Midden.—Remains of an unusual number of northern birds are contained in midden material submitted for identification by Ripley P. Bullen of the Florida State Museum. The site, Green Mound midden, is located eight miles southeast of Daytona Beach, Florida. It is underlain by dune sands and is composed of about 65 percent oyster shells, 25 percent coquina shells, and 10 percent clam shells. Excavations were made by Mr. Bullen and Frederick W. Sleight of the Central Florida Museum, in collaboration with the William L. Bryant Foundation. The tested portion of the midden was twenty-five feet high. The dates used here are estimates made by Mr. Bullen based on partial returns of radio-carbon determinations. Archaeologically the midden represents both the St. Johns I and St. Johns II periods. Mr. Bullen estimated that the age of the bottom of the mound was A.D. 500, and that of the top to be A.D. 1200.

The birds identified to the species level are as follows:

Gavia immer. Common Loon—Six elements representing both St. Johns I and St. Johns II periods.

Morus bassanus. Gannet.—One incomplete left tarsometatarsus, St. Johns II.

Phalacrocorax auritus. Double-crested Cormorant.—Six elements representing both periods.

Branta bernicla. Brant.—One left carpometacarpus, St. Johns II.

Cathartes aura. Turkey Vulture.—One partial right ulna, St. Johns II.

Larus marinus. Great Black-backed Gull.—Two partial left humeri, one incomplete right humerus, and one incomplete right ulna, representing at least three individuals from St. Johns II.

Larus argentatus. Herring Gull.—Eleven elements representing both periods.

Larus atricilla. Laughing Gull.—One left tibia, St. Johns II.

Alca torda. Razorbill.—One left ulna, St. Johns II.

Three of the species identified are northern forms, rare or unrecorded in Florida today. *Branta bernicla* winters accidentally in the state. *Larus marinus* is a rare winter straggler. *Alca torda* has been reported as far south as South Carolina, but this is the first record of this species in Florida. The other species identified are common in Florida today either as permanent residents or as winter visitants.

It is interesting to note that the three northern species were all from early

deposits of the St. Johns II period, and date approximately A.D. 850-900. The presence of these species suggests that the climate was colder at that time.

I am indebted to Dr. Pierce Brodkorb for the use of his skeleton collection, and for checking my identification of these bones.—J. Hill Hamon, *Department of Biology, University of Florida, Gainesville, Florida.*

Effects of High Air Temperature on the Bill and Claw Keratin Structures of the Tree Sparrow.—During studies on the energy balance of Tree Sparrows (*Spizella arborea*), captive birds subjected to high air temperature developed abnormalities in the bill and middle claw.

Six birds, four males and two females, trapped on February 5, 1958, near Urbana, Illinois, were immediately confined in experimental cages measuring

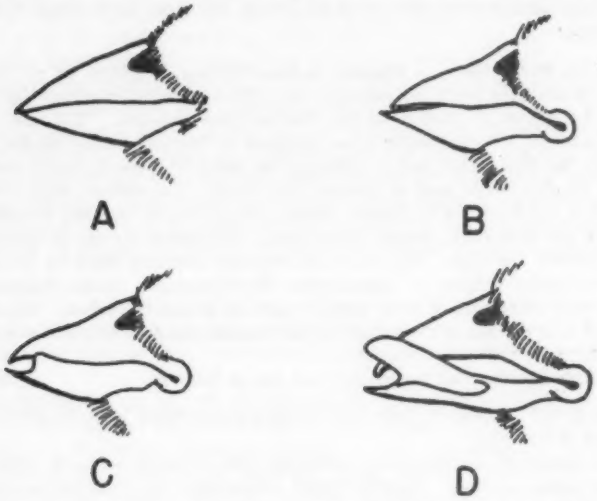


Figure 1. Stages in the development of bill deformities of Tree Sparrows at constant air temperatures above 35°C. A. Normal bill. B. After 27 days. C. After 37 days. D. After 44 days.

5 x 10 x 10 inches high, subjected to light at 10-hours photoperiod and air temperature of 10°C (50°F). On February 12, the temperature was raised to 30°C (86°F), on March 10 to 35°C (95°F), and on March 18 to 39°C (102.2°F). By March 21, one bird's lower mandible extended beyond the maxilla and small upward growths had appeared on each side of the mandible. All birds were then shifted back to 37°C (98.6°F), and the photoperiod was raised to 15 hours. On March 31, three of the six birds had mandibular growths. On April 2, all birds were placed at 39.5°C (103.1°F). By April 4, three had noticeable mandibular projections, two showed the elongated mandible, but the sixth did not develop a defect until April 7.

Stages in the development of this defect are shown in Fig. 1. The maximum growth, stage D, has two lateral mandibular projections that point forward and

curl slightly medially. The tip of the culmen is hooked. A fleshy bulb, about 1.5-2.0 mm in diameter, at the gape, appears in stage B and remains through stage D. The minimum time to gain stage B at 35°C or above was 27 days; to stage C, 37 days; and to stage D, 44 days. Birds previously exposed to 30°C, for 27 days showed no bill changes.

One bird was used in further experiments at lower temperatures. There was a gradual disappearance of the described growths, probably as a result of wear. On April 21, seven days after the last exposure to high temperature, the upper and lower jaws met evenly, the mandibular projections had decreased to a bump, similar to stage C, and the mandible height had decreased. By July 14, the bill did not differ from a normal bill and measurements corresponded with those of other caged birds.

For comparative purposes, measurements were taken on two groups of birds: a) fourteen Tree Sparrow skins collected in the field during the winter of 1956-1957; and b) eight captive birds, trapped on or before February 5, 1958, caged and fed the same as the birds at high temperatures, and maintained at a photoperiod of 10 hours, but at temperatures from 4°C (39.2°F) to −29°C (−20.2°F). All birds were taken from the same area, four miles north-east of Urbana, Illinois. Statistical analyses of eleven measurements of the bill (Baldwin, Oberholser and Worley, Sci. Publ. Cleveland Mus. Nat. Hist., 2: ix + 165, 1931) and one of the middle claw showed that the described growths represent significant changes in keratin structure (Table 1).

Results of the comparisons showed that the birds kept at high temperatures had a significant reduction in the length of the culmen, probably due in part to the decurving of the tip. Specimens collected in the field had lower bill heights and lower mandible heights, probably due to shrinkage. Birds kept at high temperatures had significantly higher mandibles than those kept at low temperatures. The length of the mandibular projection from base of notch and the height of the mandibular projection, measured from the notch to the occlusal surface of the mandible, were measurable only in the high temperature birds. No significant differences were found in the length of the mandible from gape, the greatest height of the maxilla, the greatest width of the maxilla, nor in the greatest width of the mandible.

The maxilla of collected specimens and of birds kept at low temperatures extended beyond the mandible, while the mandible of high temperature birds extended beyond the maxilla. All birds kept in cages had significantly longer middle claws than those shot in the field (probably because of less wear), but birds maintained at high temperatures showed a significant increase in claw length over those at low temperatures. The fleshy bulb was present only in the birds kept at high temperature. Dissection revealed no changes in the maxillary, premaxillary or mandibular bones.

Keratin structures are constantly growing; their normal size is maintained through wear, which may not be sufficient under certain captive conditions. Although no activity recordings were made, it was not observed that the birds at high temperature were less active than those at lower temperatures. It is doubtful that a slight decrease in activity would be sufficient to allow the described excessive growths to occur.

The abnormalities observed in the present study, although persisting at a photoperiod of 15 hours, started to develop at a 10-hour photoperiod. Ten hours

TABLE 1

COMPARISON OF BILL AND MIDDLE CLAW MEASUREMENTS OF TREE SPARROW STUDY SKINS AND CAGED TREE SPARROWS AT HIGH AND LOW TEMPERATURES.

Measurement	*Study skins* $n = 14$		*Caged at low temperature* $n = 8$		*Caged at high temperature* $n = 6$	
	Range (mm)	*Mean ± S.E.*	*Range (mm)*	*Mean ± S.E.*	*Range (mm)*	*Mean ± S.E.*
Length of total culmen	11.1–11.6	11.31 ± 0.04	11.2–12.1	11.66 ± 0.13	10.0 – 11.1	10.48 ± 0.19
Length of maxilla from gape	9.7–11.3	10.46 ± 0.12	10.0–11.8	10.84 ± 0.23	8.9 – 11.4	10.28 ± 0.35
Length of mandible from gape	9.0–11.2	9.99 ± 0.64	9.5–11.6	10.40 ± 0.22	10.0 – 12.6	10.90 ± 0.42
Height of bill at base	5.6– 6.2	5.84 ± 0.05	6.2– 6.7	6.31 ± 0.06	6.2 – 6.8	6.60 ± 0.11
Greatest height of maxilla	3.8– 4.7	4.07 ± 0.07	4.0– 4.7	4.29 ± 0.08	4.0 – 4.6	4.28 ± 0.08
Greatest height of mandible	2.7– 3.1	2.81 ± 0.04	3.2– 3.9	3.55 ± 0.10	4.0 – 4.6	4.23 ± 0.10
Greatest width of maxilla	5.2– 5.9	5.55 ± 0.05	5.4– 5.9	5.69 ± 0.06	5.4 – 5.8	5.60 ± 0.06
Greatest width of mandible	4.9– 5.8	5.34 ± 0.07	5.1– 5.8	5.54 ± 0.07	5.4 – 5.7	5.55 ± 0.05
Length of mandibular projection from notch	—	—	—	—	0 – 1.8	0.48 ± 0.32
Height of mandibular projection at notch	—	—	—	—	0.1 – 1.7	0.87 ± 0.29
Extent of maxilla beyond mandible	0 – 1.1	0.47 ± 0.09	0.2– 0.6	0.44 ± 0.05	0 – –1.6	–0.60 ± 0.25
Length of middle claw	5.0– 6.2	5.56 ± 0.09	6.5– 7.8	6.78 ± 0.21	8.7 – 10.4	9.78 ± 0.25

is not a sufficient photoperiod to cause gonadal recrudescence in the Tree Sparrow (personal observation). Moreover, such a photoperiod did not greatly differ from the natural photoperiod at this time of year. At Urbana, Illinois, the time between sunrise and sunset on February 1 is 10:07 hours and increases to 12:36 hours by March 31, with an average photoperiod of 10:41 hours in February and 11:56 in March. The environmental conditions, to which the birds would normally be exposed locally, differed greatly from the experimental conditions in temperature. The mean local outdoor temperature during February 1958 was −4.9°C (23.1°F); over all recorded years the average is −0.3°C (31.5°F). February 1958 temperatures ranged from −21°C (−6°F) to 17.2°C (63°F). During March 1958, the temperature average 2.3°C (36.2°F); over all recorded years the average is 4.5°C (40.1°F). March 1958 temperatures ranged from −4.4°C (24°F) to 14.4°C (58°F).

The fact that the keratin structures of the birds kept at high temperatures differs significantly in many respects from those of either wild birds or those maintained under identical conditions at lower temperatures suggests strongly that high air temperature is the causative agent. One possible explanation for the excess keratin production is that extreme high air temperature, approaching body temperature, increases the metabolic rate of the keratin producing cells. The increased growth would be the result of a faster mitotic rate of cells in the exposed epidermal stratum germinativum.—George C. West, *Department of Zoology, University of Illinois, Vivarium Building, Champaign, Illinois.*

The Function of the Depressor Mandibulae Muscle in Certain Passerine Birds.—The function usually ascribed to the depressor mandibulae muscle of birds is that of depressing the lower jaw. This action is accomplished by an upward pull on the lower mandible posterior to its articulation with the quadrate such that the mandible pivots downward anterior to this articulation. It has long been known, however, that in some non-passerine species this muscle has a second function—namely that of raising the upper jaw (see Hérissant, Mém. Acad. Sci. Paris 1748, 1752: 345–386). The only muscle of passerines commonly thought to have this function is M. protractor quadrati, which pulls the distal end of the quadrate forward, thereby moving the palatal and jugal struts forward and rotating the upper mandible dorsally around the frontonasal hinge. (See Beecher, Auk, **68**, 1951: 412–416, for a more complete discussion of jaw mechanics.) I believe that in certain passerine birds the depressor mandibulae serves in part to raise the upper jaw, thus complementing the action of the protractor quadrati.

The dual function of the depressor mandibulae may be explained in terms of its angle of pull to the long axis of the quadrate. If the muscle pulls parallel to the body of the quadrate, its sole action is depression of the lower jaw. On the other hand, if the muscle pulls forward with respect to the quadrate its forward component will be transmitted to the distal end of the quadrate through the lower jaw, swinging the quadrate anteriorly and raising the upper jaw. Furthermore, if there is resistance to depression at the tip of the lower jaw, the point of resistance then acts as the fulcrum of a second class lever and the force of the muscle is increased at the level of the quadrate. The forward component acting on the quadrate is therefore also increased.

Beecher has described the adaptations for feeding by "gaping" in certain species of Icteridae. Meadowlarks (*Sturnella magna*) "drive the closed bill into the ground and open it powerfully against the resistance of the earth" (*op. cit.*, p. 422). In

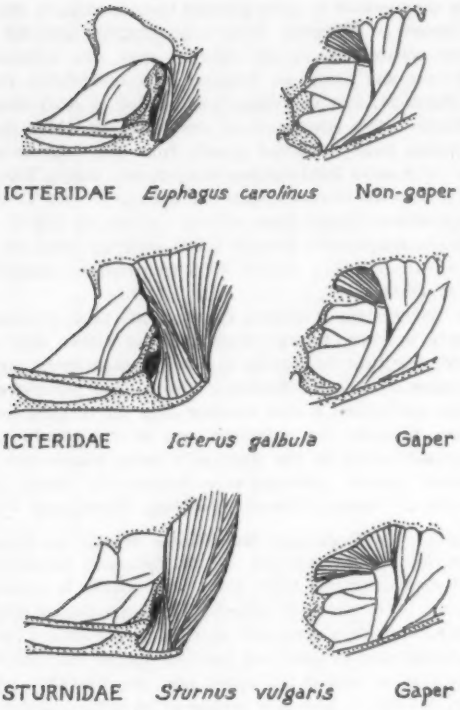


FIGURE 1. Jaw musculature of gapers and non-gaper. Left, lateral view showing M. depressor mandibulae in detail. Right, anterodorsolateral view showing M. protractor quadrati in detail. Modified from Beecher, 1951 and 1953.

orioles of the genus *Icterus*, "the feeding method involves the thrusting of the closed bill into the fruit, after which it is opened forcefully against the resistance of the pulp and skin" (p. 424). Oropendolas feed in a similar manner. Certain caciques (*Archiplanus*) "frequent larger branches and dead stumps where they pry in crevices and under bark with the bill partly opened" (p. 426). Beecher stated that in all of these birds, the depressor mandibulae and the protractor quadrati are relatively large and powerful. Associated with the increase in the depressor muscle is the enlargement of the retroarticular process, which increases the area of insertion of the muscle as well as its leverage.

Two striking features of the depressor mandibulae in gapers of the Icteridae were illustrated but were not discussed by Beecher: first, the depressor mandibulae is greatly enlarged while the protractor quadrati is only moderately enlarged (see Fig. 1); and second, the lateral portion of the depressor originates rather far anteriorly in the skull and runs at a considerable angle to the quadrate. The

lateral portion consequently pulls forward with respect to the quadrate, elevating the upper jaw while depressing the lower jaw. The efficiency of the depressor mandibulae in raising the upper mandible, as explained above, is increased by the resistance to depression of the lower mandible encountered while gaping. It seems likely to me that an important part of the force which raises the upper jaw in gapers within the Icteridae is contributed by the depressor mandibulae, and that its disproportionate increase in size relative to that of the protractor quadrati, and the alteration of its fiber direction, are adaptations to the gaping method of feeding.

In the starling (*Sturnus*), which "repeatedly parts the grass mat or probes by spreading the mandibles" (Beecher, Auk, 70, 1953: 284), the depressor mandibulae pulls parallel to the quadrate and therefore has no effect on the upper jaw. Raising of the upper jaw is accomplished solely by the protractor quadrati, which is indeed much better developed in *Sturnus* than in non-gapers or in the gapers already mentioned (Fig. 1). The different patterns of muscle development found in gapers of the Icteridae and Sturnidae represent different structural adaptations to similar feeding methods which can be explained in terms of the dual function of the depressor mandibulae in the Icteridae.

I am grateful to William J. Beecher for reading the manuscript and making several helpful suggestions.—Richard L. Zusi, *Department of Zoology, Coburn Hall, University of Maine, Orono, Maine.*

***Falco peregrinus pealei* shot in Northern Ohio.**—In February, 1958, the writer received a Peregrine Falcon frozen in the flesh through the courtesy of Mr. John A. Anderson, manager of the Winous Point Club in Ottawa County, Ohio. The bird had been shot and brought in for mounting for display in the trophy room by a hunter on November 15, 1957. Mr. Anderson presented the specimen to the University of Cincinnati, at the suggestion of Mr. Mike Nauer, then outdoor sports writer for a Cincinnati newspaper.

The bird, a beautiful immature female, was identified by the writer as belonging to the northwestern race, *F. p. pealei*, because of its generally very dark, coarsely marked plumage, particularly on the underparts. The specimen was sent for checking to Dr. Harry C. Oberholser, who confirmed the identification; pointing out that it is a typical example of this well-marked race. Dr. Oberholser showed the bird to Dr. John W. Aldrich and Dr. Herbert Friedmann, who concurred in the identification. The specimen apparently establishes the first record of this race of the Peregrine Falcon east of the Cascade and Sierra Nevada Ranges.—Emerson Kemsies, *Curator of Ornithology, University of Cincinnati, Cincinnati 21, Ohio.*

Probable Eskimo Curlew on Galveston Island, Texas.—On March 22, 1959, Messrs. Trevor Feltner and Dudley Deaver, members of the Texas Ornithological Society, saw on Galveston Island a curlew that attracted their attention because it was noticeably smaller than two Long-billed Curlews (*Numenius americanus*) between which it was feeding. On April 5, 1959, the same two men, accompanied by Messrs. Victor Emanuel and Roland Fowler, also members of the Texas Ornithological Society, saw the same, or a similar, bird on Galveston Island in a 200-acre grassy pasture about six miles north of the place of the previous observation. The party, which had a 30x telescope, identified the bird as an Eskimo Curlew (*N. borealis*). Emanuel saw it again on April 8, in the same pasture, and told me about

it the next day. Since the weather continued cold and rainy that night, I accompanied Emanuel to Galveston on April 10, in hopes of seeing the bird.

We had no difficulty in spotting the bird, at a distance of about 400 yards, in the same pasture. Many Whimbrels *(N. phaeopus)*, as well as a few Long-billed Curlews and a few Buff-breasted Sandpipers *(Tryngites subruficollis)* were feeding in the pasture; but the bird in question fed by itself. Its lower neck and breast were of a very noticeably darker (more cinnamon) shade than the same area on the Whimbrels. Seen with a 20x telescope, it seemed to lack a medial crown stripe; but the 30x telescope showed a thin medial stripe.

We took the 30x telescope into the pasture and set it up on its tripod several times as we approached the bird, which showed no nervousness, but walked about, fed, squatted in the grass, and preened itself. We finally set up the telescope less than 200 feet from the bird, and observed it at leisure. Eventually several Whimbrels wandered over near it, and made comparisons very easy. While I was looking through the telescope, a Whimbrel ran up beside and beyond the other bird, and began pecking in the same clump of grass where the other was pecking broadside to me. The opportunity for comparison could not have been better.

The bird in question was not so tall as the Whimbrel, and was several inches shorter; its bill was very much shorter and thinner; and it was altogether a smaller, more delicately formed bird than the Whimbrel. The Whimbrel's lower neck and breast were a dull *grayish;* the other bird's lower neck and breast were *buffy* shading to a darker *cinnamon*. The contrast in colors was very striking. The sides were much more heavily marked with wavy vertical bars than the sides of the Whimbrel. Several times the bird stretched its wings above its back; the entire area beneath the wings was a delicate pinkish buff. The legs were dark bluish gray; the bill was dark brown or rusty black. It was interesting to note that when this bird squatted in the grass it almost disappeared, but when the Whimbrels squatted they were always clearly visible.

Since the only two curlews that are pronouncedly smaller than the Whimbrel, with much shorter and thinner bills, are the Eskimo Curlew and the closely related Least Curlew *(N. minutus)*, and since the latter is an Asiatic-Australian species that has never been reported in North America, and is most improbable in spring in southern Texas, I am convinced that the bird I saw was an Eskimo Curlew.

About twenty members of the Texas Ornithological Society saw it in April, and were satisfied that it was an Eskimo Curlew. Among those who identified it were Dr. E. P. Edwards (Associate Director of the Museum of Natural History of Houston), Mrs. Edna W. Miner (Department of Zoology, University of Houston), and Mr. and Mrs. Charles Hamilton, who observed it from a distance of about 60 feet. Emanuel observed it with a 30x telescope from a distance of about 100 feet, as it fed alongside Whimbrels and Golden Plovers *(Pluvialis dominica);* he reports that it was "almost the same size as the Golden Plovers." Mr. Armand Yramategui was the last person to report it—April 26, 1959, in the same pasture where it was seen so often.

Joseph M. Heiser, Jr., Mrs. Edna Miner, and Miss Mabel Kaiser reported two Eskimo Curlews on April 29, 1945, on Galveston Island about three miles from the place where this one was seen (Heiser, Auk, **62**: 635). The species has not been reported from that date until now.

A few observations about the bird's habits and behavior may be of interest. The pasture in which the bird was seen most often was being grazed by cattle; it was well drained and gently rolling, with grass about three to four inches high. Though

Whimbrels, Long-billed Curlews, Buff-breasted Sandpipers, Lesser Yellowlegs, Pectoral Sandpipers, Golden Plovers, Mountain Plovers, and Killdeer were present in the pasture either continuously or occasionally throughout April, the Eskimo Curlew consorted with none of them regularly. But Emanuel and Fowler report that, on April 12, the bird flew into the pasture in company with a flock of about 20 Golden Plovers, and stayed with this flock (flying and settling with it) the entire afternoon. On April 26, Yramategui saw it keeping company with four Golden Plovers; a few hours later the plovers, and also the curlew, had disappeared. When the Eskimo Curlew was feeding, and was approached, other birds nearby generally departed before it did. But once it had been disturbed, it flushed more easily thereafter, and would fly off alone even when other birds remained. Only Feltner and Deaver heard it call. They said the call was different from that of both Whimbrel and Long-billed Curlew; they described it as "a low tremulous whistle."—George G. Williams, *The Rice Institute, Houston, Texas.*

Ed. Note: Because of variation in bill length, the conclusive feature distinguishing the Eskimo Curlew from the Whimbrel is that the former has the blackish primaries unmarked, while in the Whimbrel there are buff barrings on the inner webs of the outer primaries and on both webs of the inner primaries. This distinction is, unfortunately, of questionable value in the field, for with closed wing the Whimbrel usually shows only the plain outer webs of the longer primaries, the inner primaries being concealed by the secondaries (which are barred in both species). The character of the primaries was therefore not mentioned by Griscom in Peterson's "Field Guide to the Birds," (Rev. ed., 1947); he however distinguished the leg color of the Eskimo Curlew as "*dark greenish*, instead of bluish gray" (p. 92). Coues' "Key to North American Birds" (vol. 2, p. 844, 5th ed., 1903) similarly calls the legs "greenish-black". On the other hand, Ridgway ("Birds of North and Middle America", pt. 8, p. 412, 1919) and Forbush ("Birds of Massachusetts and other New England States", vol. 1, p. 457, 1925) respectively describe the legs of the Eskimo Curlew as "dull slate color or dark gray in life" and "grayish-blue". The only Eskimo Curlew specimen in the American Museum of Natural History with indication of soft parts is labelled "feet gray". Specimens in the American Museum of the closely allied Least (or Pygmy) Curlew or Little Whimbrel, *N. minutus*, of northeastern Asia (wintering chiefly in Australia) bear labels variously describing the legs as "light brown", "leaden grey", or "grey blue". According to Ridgway (*op. cit.*, p. 411), while *minutus* differs from *borealis*, the Eskimo Curlew, in certain toe and tarsal characters, the only plumage difference is that the Asiatic bird has pale buff (rather than cinnamon buff) axillars and under wing-coverts. N. A. Gladkov ("Birds of the Soviet Union", vol. 3, p. 316, 1951) treats *minutus* as a subspecies of *N. borealis*.

Contributors to Recent Literature

The short reviews in the Recent Literature section of 'The Auk,' vol. 76, were contributed by the following persons (their identity being indicated in most instances by initials): P. H. Baldwin, W. C. Dilger, E. Eisenmann, J. C. Howell, J. W. Hardy, D. W. Johnston, S. C. Kendeigh, R. F. Labisky, F. McKinney, H. C. Mueller, M. T. Myres, R. W. Nero, K. C. Parkes, H. C. Seibert, J. T. Taner, M. A. Traylor, A. Wetmore.

REVIEWS

Living Birds of the World.—E. Thomas Gilliard. 1958. Doubleday & Company, Inc., Garden City, N.Y. 400 pp., 400 photographs, 217 in color. Price: $12.50.—Ornithological literature is replete with synopses of the birds of numerous countries and even large sections of whole continents. There has been, however, until now no modern and fairly comprehensive treatment of the various families of the birds of the world to which the student could readily turn. The present work fills this need as effectively as any single, nontechnical volume could hope to do. In addition it is one of the most attractive bird books that has come to this reviewer's attention in a long time. There are 217 magnificently reproduced color photographs and a comparable number in black and white, that convey admirably the form and character of one or more representatives of nearly all bird families. In addition, the author has supplied authoritative information on the structure, relationships, courtship and behavior, number of species, and world range of each family. Indeed few ornithologists are more eminently equipped by way of personal experience to write about living birds from nearly all corners of the world than is the author, who has traveled widely and done much exploring in faraway places. He has a style that makes for delightful reading, and although he has held technical terminology to a minimum, he has nevertheless incorporated a wealth of technical information about the biology of birds. Much of this information, especially that dealing with birds outside North America, would not be available to bird students lacking access to an extensive ornithological library. It may be a hackneyed statement to say "here is a book that every ornithologist should have in his library," but *Living Birds of the World* richly deserves this commendation. I have it on my work desk where both I and my students refer to it repeatedly for specific information or else simply peruse its pages and superb illustrations for moments of enjoyment.—G. H. Lowery, Jr.

The Birds of the Palearctic Fauna. A Systematic Reference. Order Passeriformes.—Charles Vaurie. 1959. 762 pp, 2 maps. Price: £ 5 5s. H. F. & G. Witherby Ltd., 3 Warwick Court, London.—Ornithologists all over the world will welcome the publication of a new reference book that deals with the birds of the Palearctic—a book foreshadowed for several years by a long series of careful articles published as "Systematic Notes on Palearctic Birds" (Amer. Mus. Novit., 1953–1958). Hartert's famous manual "Die Vögel der paläarktischen Fauna" is not only out of print, but also out of date. Since 1938, when the "Ergänzungsband" to Hartert's work was concluded, many new facts concerning distribution and ecology have come to light, and a considerable number of subspecies have been described.

Vaurie did not intend to supplant Hartert's book. By omitting plumage descriptions of species and biological details, and by restricting himself mainly to references on systematics, distribution and ecology, Vaurie has produced a book of the greatest importance to advanced students of taxonomy and zoogeography. Though in principle adopting the check-list method, quoting all names proposed after Hartert and outlining the range of each species and subspecies, this book goes far beyond the usual scheme, as far as distributional, ecological and taxonomic information is concerned. Vaurie indicates the ecological niche of each species and the nature of its geographical variation, pointing out clines of color and size. He states the distinguishing characters of each subspecies and their relationships, and often calls attention to unsolved taxonomic problems at the species-subspecies level.

This is made possible by his unrivalled familiarity with the principal literature (including that published in Russia), and by his extensive studies of almost all important collections on both sides of the Atlantic.

By grading the accepted subspecies into three categories of differentiation, marked by symbols, the author has introduced a novel and commendable method. The lowest category of subspecies—the slightly differentiated local population and the intermediate stage in a cline—are placed in synonymy, marked with an asterisk. This procedure saves space and conforms with the present "tendency to de-emphasize subspecies, which has followed the realization that almost every population or segment thereof can be shown by careful analysis, statistical or otherwise, to possess some 'subspecific' characters" (Amadon, Auk, 67: 497, 1950). Future revisers will probably place in the lowest category even more subspecies than has Vaurie.

Though nearly always agreeing with the taxonomic views of the author, the reviewer is not inclined to follow him in a few cases when he seems to have oversimplified the situation. In the reviewer's opinion this has occurred in the following instances: Vaurie considers the wagtail *Motacilla lutea* to be a subspecies of *M. flava*, in spite of the fact that this distinctive form breeds within the range of *M. flava beema*, and for that reason was treated as a separate species by Sushkin (1925). In addition Sushkin considered *M. taivana* (here also treated as a subspecies of *M. flava*) to be a species, with which the reviewer agrees. Vaurie follows the lead of Meinertzhagen (1924) in including the pipit *Anthus richardi* and its palearctic allies in the Rassenkreis *Anthus novaeseelandiae*. It seems more consistent with the known facts to arrange this group into two species: a) *A. richardi*, including all palearctic forms, and b) *A. novaeseelandiae*, ranging from tropical India and Burma to New Zealand, and including *A. rufulus*. The complex of forms assembled by Vaurie in his bush warbler species *Cettia diphone* seems to consist of two species: a) *Horeites cantans* (with the subspecies *cantans* and *borealis*), and b) *Horeites diphone* (with the forms inhabiting the islands from Sakhalin to the southern Ryu Kyus). Vaurie (following Delacour) merges *Horeites* in *Cettia* and treats *fortipes* and *pallidus* as conspecific with the Javanese species *montanus*. It seems to me preferable to maintain the genus *Horeites* and to treat as full species *Horeites montanus*, *H. pallidus*, and *H. fortipes* (with the subspecies *fortipes and davidianus*). Further cases of apparent oversimplification may be Vaurie's treatment of the genus *Spelaeornis* (which follows Ripley, 1950) and of the *Phylloscopus fuscatus* assemblage (which differs from Ticehurst, 1938). The arrangement of certain rose finches might have been improved: *Carpodacus waltoni*, treated as a subspecies of *C. pulcherrimus*, seems closest to and conspecific with *C. eos*.

Americans will find of interest that all the North American rosy finches (*Leucosticte*) are treated as subspecies of the wide-ranging Asiatic *L. arctoa*. The impression should not be left that Vaurie is an extreme "lumper". A number of forms that have often been treated as subspecies are, on the basis of new evidence, given species rank; for example, the Willow Tit, *Parus montanus*, and the Corsican and Chinese Nuthatches, *Sitta whiteheadi* and *S. villosa*, are treated as specifically distinct from the North American *P. atricapillus* and *S. canadensis*, and the Serin, *Serinus serinus*, as distinct from the Canary, *S. canaria*.

Many ornithologists accustomed to Hartert's nomenclature will probably deplore Vaurie's use of a broad generic concept, with the consequent disappearance of many familiar names. Vaurie's changes were made for the sake of simplification—a

simplification that sometimes obscures significant differences. The reviewer believes no gain results from such generic mergers as *Chelidorhynx* in *Rhipidura*, *Urosphena* and *Horeites* in *Cettia*, *Spiloptila* in *Prinia*, *Moupinia* in *Chrysomma*, *Pachyglossa* in *Dicaeum*, *Hedydipna* in *Anthreptes*, *Cinnyris* in *Nectarinia*, *Chloris* in *Carduelis*, *Bucanetes* and *Erythrospiza* in *Rhodopechys*, *Procarduelis* and *Pyrrhospiza* in *Carpodacus*, and so on. This trend towards revolutionary generic consolidations, started in America by two enterprising authors, and carried to extremes by some of their followers, results in many new, and at first sight unintelligible, nomenclatural combinations. Proposals for drastic change do no harm when advanced in special articles, but they become a dangerous cause of instability if hastily adopted in widespread books of reference, where they may be copied uncritically by ornithologists. Many novel proposals, superficially persuasive on first reading, will be rejected when tested in the light of comparative biology and further taxonomic study. Fortunately, Vaurie belongs to the moderate reformers. He does not go as far in generic merging as some taxonomic left-wingers, who even propose to merge *Carpodacus* in *Carduelis* or to put all the lapwings of the world in a single collective genus *Vanellus*.

The foregoing nomenclatorial criticism is obviously a matter of opinion. It does not in the least touch on the essence of Vaurie's book, which, owing to its immense amount of important information, will be indispensable for many years to come.—Erwin Stresemann.

Birds of Alaska.—Ira N. Gabrielson and Frederick C. Lincoln. 1959. xiii + 922 pp., 10 col. pls. by E. R. Kalmbach and O. J. Murie. $15. The Stackpole Co., Norrisburg, Penna. and Wildlife Management Institute, Washington, D. C.—This timely work provides the first comprehensive account of Alaskan bird life. The authors have drawn not only upon extensive personal experience, and on the scattered previous literature, but also on the unpublished data in the files of the Fish and Wildlife Service. There are introductory chapters on the history of Alaskan ornithology, on interesting aspects of the Alaskan avifauna, migration, Alaskan ecological zones, and introduced game birds (none established). The body of the book is a summary report of each species and subspecies known from Alaska. For each form there are English, scientific and native names, a brief description, and accounts of nest and eggs, general range, Alaskan range, and "haunts and habits". The section on Alaskan range is of special interest, for much of the information is new or has appeared in scattered papers; the authority for each statement is given. The Alaskan data are, of course, more detailed than what appears in the A.O.U. Check-list, and in some cases rather different. A useful Alaskan gazetteer compiled by Myra A. Putnam, accompanied by an outline map, and a full Alaskan bird bibliography are included. Although the manuscript was completed as of July 1, 1956, an appendix calls attention to species or subspecies collected or photographed for the first time in Alaska as late as June, 1958.

Taxonomy and nomenclature are essentially those of the A.O.U. Check-list (1957), but as the main text had been prepared a couple of years before, subspecific vernaculars appear (as originally contemplated by the A.O.U. Check-list Committee) and there are divergences in a few specific names. Contrary to the Check-list, the Green-winged Teals of the Old World and the New, *Anas crecca* and *carolinensis*, are considered conspecific. Such treatment has been urged by many ornithologists; it is surprising here only because this book reports that on

the Aleutians (including the same islands) both *A. carolinensis* and the Aleutian *A. crecca nimia* (like nominate *crecca* except for larger size) are breeding—without indicating to what extent, if any, hybridization is evident.

Ornithologically Alaska is one of the least known and most interesting parts of North America. It still contains large areas of unspoiled wilderness and is a natural laboratory for the study of speciation and evolutionary trends. The 321 species reported are represented by 414 races. Many Old World species occur in Alaska as breeders or wanderers, and some meet or approach their New World representatives. As the Rockies reach the Pacific coast in Alaska, that barrier between eastern and western forms disappears, and the warming of the climate has enabled southern birds to move increasingly into arctic regions. The various island chains provide striking examples of insular subspeciation. This book will serve as a foundation and stimulation for the detailed zoogeographic and ecological studies that need to be done.—EUGENE EISENMANN.

The Avifauna of Trinidad and Tobago.—G. C. A. Junge and G. F. Mees. 1958. Zoologische Verhandelingen, no. 37: 1–172, maps, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.—This comprehensive report, designed to cover all birds recorded from the area, supplements that of Belcher and Smooker entitled "Birds of the Colony of Trinidad and Tobago" (Ibis, 1934–1937). Written in English, it includes 365 species, and is based chiefly on collections obtained by the junior author from June 1953 to February 1954, comprising 835 specimens of 178 species. One new subspecies, *(Pipra erythrocephala flavissima)*, is described, and several forms are added to the avifauna of Trinidad.

In addition to field observations and remarks on specimens taken, short descriptions are given of every species. These will be helpful to the visiting ornithologist, for there is as yet no hand-book on the birds of these rich neotropical islands. There is also a useful bibliography.

The sequence of Oscine families will confuse American ornithologists, for the "Emberizidae", which here include the "Richmondeninae", "Thraupinae", "Tersininae", and "Coerebinae", are placed after the thrushes and gnatcatchers, and are separated from the Fringillidae by the Parulidae, Vireonidae and Icteridae. If the authors had perused more carefully the "Catalogue of Birds of the British Museum" and the "Catalogue of Birds of the Americas" they would have noted that *Pardirallus maculatus, Chlorestes notatus, Dendroica tigrina,* and *Dendroica fusca* have been recorded from Tobago, and *Sporophila americana* from Trinidad. *Panyptila cayennensis* is listed from Tobago—presumably in reliance on the statement of Belcher and Smooker that Dalmas' collector obtained it there; but the only swift recorded from Tobago by Dalmas is *"Chaetura guyanensis* Hartert", the bird now called *Ch. cinereiventris lawrencei* Ridgway.

Several species accepted as indigenous to Tobago seem to have been based solely on sight identifications and, in the opinion of this reviewer, should have hypothetical status. Among the latter I would even include *Butorides striatus*, considered by Mees to be the "most common species of heron on both islands", although all recorded specimens of the genus from Tobago, including one obtained by Mees, have been *virescens*. It is apparent that much remains to be learned concerning the avifauna of Trinidad and Tobago, and that the time has come for selective collecting.—J. BOND.

An Australian Bird Book. A Complete Guide to the Birds of Australia.—J. A. Leach. 9th ed.; revised and rewritten by P. C. Morrison. 1958. xvi + 224 pp. 32 col. pls., many figs. Price, 32S. 6d. Whitcombe & Tombs Pty. Ltd., 332 Collins St., Melbourne, Australia.—Leach died in 1929. In the ensuing nearly thirty years extensive progress in ornithology had effected no corresponding impression on his "An Australian Bird Book", once an extremely useful volume for teachers, students and bird watchers, well-illustrated and concise. The reviser, P. Crosbie Morrison, was not a scientific ornithologist, but an all-around naturalist with an extensive listening public. He could reach them by the presentation of material in the popular style with which they were familiar. Accordingly Leach's famous "lecture" has been practically re-written, the descriptions of species have been reconstructed, old illustrations restored and new half-tone pictures interspersed.

Whilst it was desired to retain the general scientific arrangement of earlier editions, based on Bowdler Sharpe, the need for modification was apparent, and Peters' "Check-list" (to the extent of the published volumes) and Wetmore's systematic classification were largely followed as to the grouping of genera within orders, though not necessarily as to the sequence of orders *inter se*. Morrison's death prior to completion of his revision resulted in the Passeriformes being presented precisely as Leach had dealt with that group.

Despite the attendant weaknesses from the viewpoint of technical ornithology, this revision will again make available to Australian bush-walkers and bird observers what Leach intended—a handy field guide. To American visitors, and others interested in the unique Australian avifauna, the new Leach will be useful and instructive.—CHARLES E. BRYANT.

Pirates and Predators. The Piratical and Predatory Habits of Birds.—Colonel R. Meinertzhagen. 1959. 230 pp., 18 col. pls., chiefly by G. E. Lodge; 26 monochrome pls., from photographs and paintings. Price, 70 s. Oliver and Boyd, London.—This splendidly produced book which has been under preparation for some years, is, as the author told me, sold at cost. The paintings by the late G. E. Lodge were evidently commissioned for the work as they illustrate incidents here related in print for the first time. Among them are paintings of several little-known birds of prey, such as the Teita Falcon and the black Korean form of Steller's Sea Eagle. A few of the photographs have, I believe, been published elsewhere, but some of them, such as the magnificent view of a diving osprey are well worth having in book form.

The text considers the hunting habits of predatory birds and also their piratical ways of stealing food from other birds. There is also a section on what Colonel Meinertzhagen calls "autolycism", or the manner in which birds make use of man and his paraphernalia, including buildings.

The treatment is highly anecdotal, and even capricious, while the coverage of the literature, as the author himself admits, is by no means complete. Yet many of the observations from the author's varied experiences will be of interest to the student of bird behavior. The book deals for the most part with hawks and owls, but also with "amateur" predators in many families, such as gulls, crows, and others.

In 1957 the reviewer had the pleasure of accompanying a party including Colonel Meinertzhagen on an 1800 mile motor trip in Africa. As I sat beside the laconic and uncomplaining campaigner, then in his 80th year, his gun poised always across his knees, he occasionally marked the course of a distant Bateleur, or a hillside on which he had led a military skirmish in the First World War. One

came to see in him a spirit as untamed and free as that of the eagle whose shadow we traced across the stark African landscape.—DEAN AMADON.

Georgia Birds. Thomas D. Burleigh. 1958. xix + 746 pp., 35 col. pls. by George M. Sutton, 13 photo. pls., maps, text figs. Price $12.50. Univ. Oklahoma Press, Norman, Okla.—This handsomely printed, but exceptionally bulky tome follows the format usual in many recent state bird books. A scholarly history of Georgia ornithology by W. W. Griffin, and a useful description of the physiographic and biogeographic regions by R. A. Norris, introduce the systematic species account. Subspecies (where more than one occurs in Georgia) are given the same treatment as species, and vernacular subspecific names are supplied. Under each included form data are provided as to distribution, status in Georgia (including migration and egg dates), and "habits and recognition" (including habitat, nesting, general behavior and appearance). A Georgia bibliography and a hypothetical list of birds reported but not collected complete the work. The photographs of Georgia habitats are very fine. Sutton's watercolors each depict a single species, mostly familiar birds; several illustrate local subspecies or include little-known nestling plumages. We wish there had been more of these. The color reproduction will prove disappointing to those who have seen the originals.—E. EISENMANN.

Check-list and Bibliography on the Occurrence of Insects in Birds' Nests. —Ellis A. Hicks. 1959. 681 pp. Iowa State College Press, Ames, Iowa. Price, $8.50. This work is of world-wide scope and consists of two check-lists, a bibliography, and an index. The entomological check-list gives, under each insect order, family, and species, the birds in whose nests such insect has been found, with the bibliographic reference. The ornithological check-list cites, under each bird species, in a similar manner, the insects found. In each case the orders (and, within each taxon, the families, genera, and species) are listed alphabetically. The index includes all taxa above species, and thus facilitates ready reference.—E. EISENMANN.

A Day at Flores Moradas. Recorded by W. W. H. Gunn. 12" 33 1/3 RPM. Price, $5.95. Federation of Ontario Naturalists, 187 Highbourne Road, Toronto 7, Canada. (In U. S.: Curtiss and Weir, 54 Priscilla Place, Trumbull, Conn.)—This is the first published record of South American bird voices. It was made in Venezuela, at a cattle ranch on the Llanos near the Guárico River. The record is designed to recreate the dawn to dusk atmosphere at the ranch, with the voices of some thirty birds and a few other animals. Among the characteristic species recorded are Hoatzin (*Opisthocomus*), ibis (*Phimosus infuscatus*), lapwing (*Belonopterus*), Black-collared Hawk (*Busarellus*), caracara (*Caracara*), wren (*Campylorhynchus nuchalis*), mockingbird (*Mimus gilvus*), cowbird (*Molothrus bonariensis*), and oriole (*Icterus nigrogularis*). It is very interesting to compare the vocalizations of many of the birds here recorded with those of their allies farther north. Species are identified only on the jacket, which unfortunately misspells several of the scientific names. The English names employed are in some instances unfamiliar. Unless acquainted with the technical designations, most Americans would fail to recognize the Black-bellied and White-faced Tree Ducks under the names "Red-billed" and "Black-billed" or to realize that the "Pygmy Owl" recorded is the species (another race) called Ferruginous Owl in the A.O.U. Check-list. The "Inca Dove" recorded is the Scaled Dove (*Scardafella squammata*), usually regarded as a species different from the northern *S. inca*. These comments do not detract from the high quality or value of the recording; they merely point to the growing need for some uniformity in English nomenclature on a Western Hemisphere basis.—E. EISENMANN.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

Anatomy and Embryology

Eber, G. 1956. Vergleichende Untersuchungen über die Ernährung einiger Finkenvögel. Biol. Abhandl., **13/14**: 1–60.—Comparative studies on the feeding of eight well-known European finches, treating habitat, food niches, food and anatomy. The drawings of tongue, bill, ceratobronchials, and intestines of the various species will interest anatomists and anatomical systematists.—E. E.

Setty, L. R. 1958. The cutaneous muscles of the Adelie Penguin *(Pygoscelis adeliae)*. Journ. Wash. Acad. Sci., **48**: 387–388.

Behavior

Backen, E. P. 1958. Courtship behaviour of the Sharp-tailed Sandpiper *(Erolia acuminata)*. Emu, **58**: 267–270.

Borror, D. J. 1959. Variation in the songs of the Rufous-sided Towhee. Wilson Bull., **71**: 54–72.—The songs of *Pipilo erythrophthalmus*, analyzed with audiospectrographs, possessed different introductor notes and trills, which were combined in 93 different song patterns.—J. T. T.

Bradley, E., and J. Bradley. 1958. Notes on the behaviour and plumage of colour-ringed Blue Wrens. Emu, **58**: 313–326.—A year's study of color-banded Superb Blue Wrens *(Malurus cyaneus)* in Sydney, Australia revealed that the birds lived in groups consisting of one female and four or five full-plumaged males, all of which cared for the young.—E. E.

Cooper, R. P. 1958. Pallid Cuckoo feeding young. Emu, **58**: 67–68.—A stub-tailed fledgling of the Australian parasitic cuckoo, *Cuculus pallidus*, was observed being fed mistletoe by about ten individual birds, including two species of honeyeaters *(Meliphagidae)* and an adult of its own species. Over the protests of the honeyeaters, the adult cuckoo fed the young bird six times. Apparently the food call and open mouth of the young bird, which stimulated so many birds of other species to feed it, also attracted the adult cuckoo.—E. E.

Davis, D. E. 1959. Observations on territorial behavior of Least Flycatchers. Wilson Bull., **71**: 73–85.—The territorial behavior of *Empidonax minimus* resembles that of other members of the genus. Nesting in southwestern Virginia is described, and song and call notes are described with their apparent function. —J. T. T.

Dilger, W. C., and P. A. Johnsgard. 1959. Comments on "species recognition" with special reference to the Wood Duck and the Mandarin Duck. Wilson Bull., **71**: 46–53.—A general discussion of the problem.—J. T. T.

Gilliard, E. T. 1959. The courtship behavior of Sanford's Bowerbird *(Archboldia sanfordi)*. Amer. Mus. Novit., **1935**: 18 pp.—First observations of an occupied bower of this species, which Gilliard discovered on Mt. Hagen, New Guinea, in 1950. Most of the paper consists of a minute-by-minute verbatim transcript of field notes covering *all* avian activity seen or heard from a blind at 8520 feet on Mt. Hagen, between 6:32 and 10:05 A.M., July 14, 1956. The bower is a mat of ferns and vines adorned with snail shells, bamboo strands, and other objects When the female comes to the bower, the male assumes a prostrate, "infantile" attitude, crawling toward the female while chewing on a piece of vine and fluttering the wings. This "female-dominant" behavior appears to be unique in

the family. The golden crest of the male plays little or no part in the display: it is absent in the related *A. papuensis*, the courtship behavior of which is unknown.—K. C. P.

GILLIARD, E. T. 1959. A comparative analysis of courtship movements in closely allied bowerbirds of the genus *Chlamydera*. Amer. Mus. Novit., **1936**: 8 pp.—Evidence offered in support of the author's "transferral effect" theory that elaborately decorated bowers have replaced bright plumage in displays of certain dull-colored species. Males of *C. nuchalis* possess an irridescent erectile crest which is lacking in the sexually monomorphic *C. cerviniventris*. The latter possesses in vestigial form the awkward crest-displaying courtship motions typical of crested species, but objects held in the bill of the male play an augmented role in the display of the crestless *C. cerviniventris*. The sequence of the evolution of the display movements and of the bright crest is postulated.—K. C. P.

MAINARDI, D. 1958. L'insorgenza dell'istinto parentale in un ibrido sterile fra *Columba livia* e *Columba albitorques*. Zoo, **4** (3): 60–64. Boll. Giardini Zoologici di Milano-Torino-Varallo.—Hybrids between Rock and Ring Doves are fertile if males, completely sterile (not even able to lay eggs) if females. A pair of such hybrids which had copulated without producing eggs, was supplied with an artificial nest and two eggs of a domestic pigeon. Both hybrids incubated and when one egg hatched (the other proving infertile) both fed the young with "pigeon milk" secreted in the crop, and later with grain—demonstrating that incubation behavior, feeding of young and production of pigeon milk are independent of egg laying. Comparison is made with the behavior of hybrids between *C. livia* and *C. guinea*, and of *Phasianus and Gallus*. (In Italian; English summary).—E. E.

MCBRIDE, G. 1958. Relationship between aggressiveness and egg production in the domestic hen. Nature, **181**: 858.

MORRIS, D. 1958. The comparative ethology of grassfinches (Erythrurae) and mannikins (Amadinae). Proc. Zool. Soc. London, **131**: 389–439.—A taxonomic study, based chiefly on behavior in captivity, of two tribes of Estrildinae. The estrildines "form a very natural and distinct subfamily of the Ploceidae, from the point of view of their behavior." Delacour's arrangement is in most respects confirmed by ethological studies; the major changes: the Red-browed Finch of Australia *"Estrilda" temporalis* is considered not a waxbill but a grassfinch and is removed to *Zonaeginthus*, and certain genera submerged are resurrected as genera or subgenera.—E. E.

PIIPARINEN, T., and L. TOIVARI. 1958. Über die Tagesrhythmik im Gesang des Sprossers *(Luscinia luscinia)*. Orn. Fen., **35**: 65–70.—The daily rhythm of the Sprosser or Thrush Nightingale in Finland at 61° 4′ N. between May 21 and June 26 was elaborately studied. The peak of song intensity was between 1:00–2:00 A.M., though birds sang very steadily from midnight to 4:00 A.M., and could be heard intermittently throughout the day, particularly after 5:00 P.M. (In German; Finnish summary).—E. E.

PREUSS, N. O. 1959. [The distribution of the Dipper (*Cinclus cinclus* (L.)) in Denmark, with remarks about its behaviour in the winter quarters.] Dansk Ornith. Foren. Tidssk., **53**: 1–19.—Maintains a winter territory. Threat postures are illustrated. (In Danish; English summary).—E. E.

THORPE, W. H. 1958. Further studies on the process of song learning in the chaffinch *(Fringilla coelebs gengleri)*. Nature, **182**: 554–57.—Young, acoustically

isolated birds will sing a more complicated song if together than if isolated. This mutual stimulation may lead to songs as complex as, although quite different from, the adults. Hand-reared isolates can be tutored to sing songs unlike any produced by wild birds. Song pattern can be learned only during first 13 months.—H. C. S.

VON HAARTMAN, L. 1958. The incubation rhythm of the female Pied Flycatcher *(Ficedula hypoleuca)* in the presence and absence of the male. Orn. Fen., **35**: 71–76.—There seems to be a correlation between the time spent on the nest by an incubating female and the frequency with which she is fed by the male. Field observations were confirmed by removal of a male. The duration of sessions both on and off the nest increased, but the total amount of time on the nest decreased as did the female's weight.—E. E.

Diseases and Parasites

CLAY, T. 1958. Revision of the Mallophaga genus *Degeeriella* from the Falconiformes. Bull. Brit. Mus. (Nat. Hist.). Entomology, **7**, no. 4: 5–208. Price, 30s.—The tabular review and discussion of the raptors that are hosts to various species of this mallophagan genus may throw light on hawk taxonomy. Significantly, the genus *Gampsonyx*, here listed under Falconidae (following Peters), unlike any falcon, carries a *Degeeriella* of the same species group as *Elanus*. This supports the relationship indicated by recent anatomical and molt studies (see Auk, **76**: 360–36, 1959).—E. E.

EICHLER, W. 1958. Bird lice: a biological test for ornithologists. Emu, **58**: 1–4.—A general account of the behavior of feather-eating bird lice (Mallophaga) and the generalizations that have been drawn: Fahrenholz's rule—related birds have related bird lice in common; Szidat's rule—the more highly-organized birds have correspondingly highly-organized parasites; Eichler's rule—the bird genera with fewer species harbor a smaller variety of bird lice.—E. E.

Distribution and Annotated Lists

ALVAREZ DEL TORO, M. 1958. Lista de las especies de aves que habitan en Chiapas. Endemicas, emigrantes y de paso. Rev. Soc. Mex. Hist. Nat., **19**, nos. 1–4: 73–113.—The species and subspecies recorded from the Mexican state of Chiapas (624 forms) are listed, indicating whether the bird is a winter visitant or passage migrant, the part of the state where each occurs (exact localities in the case of the less known birds), and often habitat. Apparently for the first time the Ocellated Turkey, *Agriocharis ocellata*, is reported for Chiapas and the Pacific slope. This list has a special value because it is based on unrivalled personal field experience, as well as available literature. The reviewer notes the inadvertent omission of *Cyanerpes lucidus* (see Berlioz, Bull. Mus. Hist. Nat. Paris, ser. 2, **11**: 375, 1939).—E. E.

ARNHEM, R. 1959. Le Fuligule Morillon, *Aythya fuligula* (L.), nicheur en Belgique. Gerfault, **49**: 43–51.—Discusses the increase in the breeding range of the Tufted Duck since 1900. (The similar spectacular spread of the allied New World Ring-necked Duck, *A. collaris*, suggests a common cause.) (In French.) —E. E.

BEHLE, W. H., J. B. BUSHMAN, C. M. GREENHALGH. 1958. Birds of the Kanab area and adjacent high plateaus of southern Utah. Univ. Utah Biol. Ser., **11**, no. 7: 1–92.—The area covered includes Bryce Canyon National Park and Cedar Breaks

National Monument, though no collecting was done within these reservations. The list contains breeding information and some taxonomic discussion. Ecological information is particularly full, and is given in convenient tabular form for the permanent and summer residents.—E. E.

BOETTICHER, H. VON. 1958. Die Möwen der Erde und ihre geographische Verbreitung. Der Falke, **6**: 13–17, 48–54.—This paper represents von Boetticher's final views as to the classification and distribution of the gulls of the world. He recognizes three genera: *Pagophila* for the Ivory Gull, *Leucophaeus* for the Dolphin Gull, and *Larus* for all the rest. The maps give a useful general picture of gull distribution, but they are not up-to-date for the breeding ranges of many New World forms. As a result, von Boetticher designates as allopatric subspecies a number of gulls now known to be sympatric. Thus, following Stegmann (1934), he lumps in the species *L. fuscus* the Herring, Lesser Black-backed, California and Iceland gulls (including their subspecies); yet the Herring Gull nests in localities where the other three are breeding. He includes the Ring-billed Gull as a subspecies of the Mew Gull, *L. canus*, overlooking the fact that in western Canada the former is sympatric with *L. c. brachyrhynchus*. The Glaucous-winged Gull is regarded as a subspecies of the Glaucous Gull, *L. hyperboreus*, although recent information indicates they occur together as breeders in Alaska. The Western Gull, *occidentalis*, the Siberian *schistisagus*, and the Southern Hemisphere *dominicanus* are considered conspecies of the rather sedentary North Atlantic Great Black-backed Gull, *L. marinus*. Similarly, the South American *maculipennis* is lumped as a race of the Palearctic *L. ridibundus*. In the last two cases the forms are certainly allopatric—the ranges of the supposed conspecies are separated by thousands of miles—but it is hard to find basis for any assumption that they would freely interbreed (were their ranges to meet), when other allied gulls apparently resembling each other as much in morphology and behavior, maintain reproductive isolation in the zone of overlap. It is interesting to map presumed zoogeographic representatives, but such relationship can be shown by calling the group a superspecies, without confusing this concept with that of the biologic species.—E. E.

GUIGUET, S. J. 1958. The birds of British Columbia (6) Waterfowl. Brit. Col. Prov. Mus., Handbook no. **15**: 1–84. Price 25 cents.—A good popular account of the local Anseriformes, designed for amateurs and hunters, with each species illustrated attractively by Frank L. Beebe.—E. E.

HELMINEN, M. 1958. Occurrence of the Red-flanked Bluetail *(Tarsiger cyanurus)* in Finland and some remarks concerning its expansion to the west. Orn. Fen., **35**: 51–64.—Since 1949 this typical representative of the Siberian taiga zone has been noted annually in eastern Finland—evidence of a recent westward invasion. —E. E.

KNORR, O. A. 1959. The birds of El Paso County, Colorado. Univ. Colo. Stud., Ser. Biol., **5**: 1–48. Price, $1.—Annotated list for the Colorado Springs–Pike's Peak area; with interesting comparison of the changes since Aiken and Warren's 1914 list.—E. E.

MCCANDLESS, J. B. 1958. A Field Guide to the Birds of Puerto Rico. A supplement to Roger Tory Peterson's Field Guide to the Birds. viii + 68 pp. Price, $2. (Order from Dr. J. B. McCandless, Box 1079, Mayaguez, Puerto Rico.)—This useful booklet lists (without illustrations) the 190 species known to occur in Puerto Rico, giving English, Puerto Rican, and scientific names, and indicating

local status. Field-marks are described for the 53 species not included in Peterson's continental guide, with page references to that book for the others. The work is introduced by a very helpful chapter on bird finding in Puerto Rico and is concluded by a supplemental list of extirpated species and those threatened with extirpation, a "problematical list", a short bibliography, and indexes.—E. E.

MERTENS, R. 1958. Quer durch Australia. Biologische Aufzeichnungen über eine Forschungsreise. 200 pp., 8 col. photos., 40 figs. Verlag Waldemar Kramer, Frankfurt am Main, Germany.—A discursive account of the 1957 Senckenberg expedition across Australia. Included are pictures of the landscape, attractive drawings of and brief comments on many animals (including some birds). The index lists the generic names of the plants and animals mentioned. (In German.)—E. E.

PATERSON, J. M. 1958. Check list of birds of the Eastern Cape Province. 71 pp. Eastern Cape Wild Bird Society, c/o Museum, Port Elizabeth, South Africa.—An annotated list of 445 forms, plus an appendix of an additional 53 that are rare or doubtful.—E.E.

RIPLEY, S. D., and D. S. 1958. Notes on a collection of birds from Mindoro Island, Philippines. Peabody Mus. Nat. Hist. Yale Univ., Bull., **13**: 1–81.—Report on 122 forms collected in 1954, with notes on taxonomy, habitat, etc. —E. E.

RUSCHI, A. 1953. Os trochilideos: *Agyrtrina lactea lactea* (Lesson); *Heliomaster squamosus* (Temminck); *Lophornis chalybeus* (Temminck); *Discosura longicauda* (Gmelin); e *Chrysolampis mosquitus* (Linnaeus) novos para o Estado do Espírito Santo e as causas do seu recente aparecimento. Bol. Mus. Biol. Prof. Mello-Leitão. Biologia, no. **16**: 1–11. Santa Teresa, Espírito Santo, Brasil.—Hummingbirds new to the Brazilian state of Espírito Santo and the causes of their recent appearance. (In Portuguese.)—E. E.

SUMMERS, L. 1958. Bird life of Grand Forks County, North Dakota. Proc. N. D. Acad. Sci., **12**: 69–73.—An analysis of the avifauna of a prairie area in the Red River Valley.—E. E.

WOOD, M. 1958. Birds of Central Pennsylvania. Penna. Agr. Exper. St. Bull., **632**: 1–46.—A check-list, giving status of the 260 species recorded within 15 miles of University Park, site of Pennsylvania State University.—E. E.

ECOLOGY AND POPULATION

HOFFMANN, L. 1959. Esquisse ecologique de la Camargue à l'intention des ornithologistes. La Terre et la Vie, 1959: 26–60.—The ecology of the Camargue, southern France, from the ornithologists' viewpoint. (In French.)—E. E.

HOFFMANN, L. 1959. La nidification des Flamants en 1957. La Terre et la Vie, 1959: 74–76.—Between 4000–4500 pairs of flamingos nested in the Camargue in 1957, rearing successfully 2200–2500 young. The Herring Gull, which has been increasing, is a predator on the young.—E. E.

KEAST, A. 1958. The influence of ecology on variation in the Mistletoe-bird *(Dicaeum hirundinaceum)*. Emu, **58**: 195–206.—The Australian flower-pecker is an exceptional case of a small passerine that occurs with almost no geographic variation throughout the continent. This is presumably the result of nomadic habits. This bird is a major factor in dispersing mistletoe, for the gizzard is adapted to enable the berries to pass to the intestine with only the gelatinous capsules removed and with the seeds intact and sticky.—E. E.

REUTER, M. 1958. Tierphänologische Beobachtungen in Finland 1951–1955.

Utgifna af Finska Vetenskaps-Societeten, **100**, no. 2: 1–56.—Animal phenological observations in Finland, consisting chiefly of arrival and departure dates for a large number of bird species from some seventy-eight localities. There are also dates of nest building by the Hooded Crow, and of display by the Capercaillie and Black Cock, as well as some data on a few other conspicuously seasonal non-avian animals. (In German.)—E. E.

ROOTH, J., and F. M. BRUIJNS. 1959. [The Sandwich Tern (*Sterna s. sandvicensis* Lath.) as a breeding bird in the Netherlands.] Limosa, **32**: 13–22.—Total population fluctuated between 2500–4000 pairs in 1954–57; number of pairs in each colony fluctuates much more. (In Dutch; English summary.)—E. E.

SALOMONSEN, F. 1958. The present status of the Brent Goose (*Branta bernicla* (L.)) in Europe. Vidensk Medd. Dansk. Naturh. Foren., **120**: 43–80. Reprinted by International Wildfowl Research Bureau, Publ. no. 4.—Data on distribution, migration, and population. The Western European population seems in danger of extirpation. Protective measures are suggested.—E. E.

EVOLUTION

DANFORTH, C. H. 1958. *Gallus sonnerati* and the Domestic Fowl. Journ. Heredity, **49** (4): 167–169.—Crossings in captivity of Gray Junglefowl with Red Junglefowl and domestic fowl suggest that the Gray Junglefowl might have contributed to the production of certain domestic breeds.—E. E.

GILLIARD, E. T. 1959. The ecology of hybridization in New Guinea honeyeaters (Aves). Amer. Mus. Novit., 1937: 26 pp.—Continuation, with new material, of a study initiated by Mayr and Gilliard (Condor, **54**: 325–337, 1952) on hybrid swarms of *Melidectes*. Contrary to previous treatment, *M. belfordi* and *M. rufocrissalis* are considered to be species, which hybridize where man has created new "edge" habitats by cutting forests. The history of the genus in New Guinea is postulated. Two named forms, *griseirostris* and *stresemanni*, are recognized as subspecies of *belfordi* on the grounds of morphological resemblance, although a good case is made for these two populations being isolated and stabilized derivatives of hybrid swarms.—K. C. P.

MOREAU, R. E. 1958. The *Malimbus* spp. as an evolutionary problem. Rev. Zool. et Botan. Afr., **57** (3–4): 241–255.—Study of 8 closely allied African Ploceidae, almost all of which are known to overlap, though having a similar ecology.—E. E.

MOREAU, R. E., and H. N. SOUTHERN. 1958. Geographical variation and polymorphism in *Chlorophoneus* shrikes. Proc. Zool. Soc. Lond., **130**, pt. 3: 301–328.—A taxonomic and distributional study of what is probably the most remarkable case of multiple polymorphism in birds.—E. E.

SAMMALISTO, L. 1958. Interracial hybridization as an adaptation mechanism in the Fennoscandian Yellow Wagtail (*Motacilla flava* L.) population. Ann. Acad. Scient. Fennicae. Ser. A. LV Biologica **41**: 1–46.—In Finland the nominate form and the eastern race *thunbergi* meet and freely interbreed forming various intermediates that closely resemble other races. The author believes that adaptively hybrid males are superior to the parental forms on treeless bogs and marshes; but females show no superiority. A sex-linked heterosis seems to be involved.—E. E.

GENERAL BIOLOGY

CURIO, E. 1959. Verhaltensstudien am Trauerschnäpper. Beiträge zur Ethologie und Ökologie von *Muscicapa h. hypoleuca* Pallas. Paul Parey, Berlin, SW 61,

Lindenstrasse, Berlin, Germany. Z. Tierpsychol. No. **3**: 1–118. Price, DM 25.—A most elaborate five-year study of the life history, ethology, and ecology of the Pied Flycatcher, based on color banding a population of 258 adults and 710 nestlings in the wild, and work with 8 nestlings reared in captivity for almost three years. There are numerous photographs, drawings, tables and graphs. The paper is admirably organized for convenience of reference. (In German; unusually full English summary.)—E. E.

DOWNES, W. 1959. Epidemiology Report. Ornithology. *In* 1958 Annual report of the Trinidad Regional Virus Laboratory. Five Year Summary: 42–58.—Data on virus isolation and inoculations in Trinidad birds, and tables on nesting season and duration of nesting period. Although among land birds the main nesting season is from April to July, with the peak in April (the beginning of the rainy season), among the non-passerine marsh birds the four months with most nesting species are June through October, with the peak in August. Information on migration is also of interest.—E. E.

HENSLEY, M. M. 1959. Notes on the nesting of selected species of birds of the Sonoran desert. Wilson Bull., **71**: 86–92.—On 16 species in the Organ Pipe Cactus National Monument, Arizona.—J. T. T.

HERROELEN, P. 1957–1959. [On the breeding biology of the Barn Swallow, *Hirundo rustica* L.] Gerfault, **47**: 115–126, 265–278, **49**: 11–30.—A five year study of *H. r. rustica* in Belgium. (In Flemish; French summary.)—E. E.

HOOGERS, B. J., and H. N. KLUIJVER. 1959. [A breeding colony of Black-crowned Night Herons (*Nycticorax nycticorax* L.) in the vicinity of Wageningen, Netherlands.] Limosa, **32**: 8–13. (In Dutch; English summary.)

KURODA, N. 1955–1957. Field studies on the Grey Starling, *Sturnus cineraceus* Temminck. Misc. Rep. Yamashina Inst. Orn. and Zool., No. **7** (1955): 7–19 [277–289]; No. **8** (1956): 8–18 [318–328]; No. **9** (1956): 27–38 [375–386]; No. **10** (1957): 27–40 [413–426].—An important and detailed study. The first two parts cover mostly roosting and feeding behavior, the last two breeding biology. (In Japanese; most tables and a good summary in English.)—K. C. P.

LEBRET, T. 1959. [The distances between feeding grounds and nocturnal roosts of geese in the Netherlands.] Limosa, **32**: 23–30.—Observations on five forms of wild geese. (In Dutch; English summary and captions to table.)—E. E.

MEANLEY, B., and A. G. MEANLEY. 1959. Observations on the Fulvous Tree Duck in Louisiana. Wilson Bull., **71**: 33–45.—*Dendrocygna bicolor* feeds and nests in rice fields in southwestern Louisiana. Annual movements, breeding habits, and development of young are described. Some damage to rice has occurred.—J. T. T.

PADGETT, C. A., and W. D. IVEY. 1959. Coturnix Quail [*Coturnix coturnix japonica*] as a laboratory research animal. Science, **129**: 267–268.—The Japanese race of the common Eurasian quail reproduces when six weeks old; a few lay at 38 days old and fertility may be as high as 90 per cent at 50 days. In an incubator at 100° F. eggs hatch in 16 days ± 8 hours. 60–70 per cent of fertile eggs hatch. Laying occurs from April through September.—E. E.

RUSCHI, A. 1953. Ninhos, ovos e algumas observações sôbre os Trochilideos: *Psilomycter theresiae theresiae* (Da Silva Maia); *Lophornis vereauxii* Bourcier; *Lophornis gouldii* (Lesson); *Phaethornis nattereri* (Berlepsch); *Chrysuronia oenone josephinae* (Bourcier & Mulsant); *Gouldomyia langsdorffi melanosternon* (Gould) e *Anthracothorax viridigula* (Boddaert). Bol. Mus. Biol. Prof. Mello-Leitão. Biologia, no. 15: 1–13. Santa Teresa, Espírito Santo, Brasil.—Nesting

data of certain Brazilian hummingbirds, and notes on behavior and nestling plumages. (In Portuguese.)—E. E.

SKUTCH, A. F. 1959. Life history of the Black-throated Trogon. Wilson Bull., **71**: 5–18. Color plate by D. R. Eckelberry.—*Trogon rufus* inhabits heavy forests in Central and South America. Its habits and behavior are compared with other trogons and its nesting is described in detail.—J. T. T.

WARHAM, J. 1958. The nesting of the Australian Gannet [*Sula serrator*]. Emu, **58**: 339–369.—Data on courtship display and reproductive activities; with many fine photos.—E. E.

WESTERSKOV, K. 1958. Incubation period in the pheasant. Emu, **58**: 139–151.—For *Phasianus c. colchicus* and *P. c. torquatus* the incubation period in a still-air incubator ranged between 22 days and 23 days 22 hours (mean, 23 days 3 hours). Birds naturally incubated are likely to require a few hours longer, because of cooling during the periods of non-attendance by the hen. If a hen pheasant is forced to stay away longer than usual, it is still possible for eggs to hatch, though the incubation period may be 2–4 days longer than normal. If eggs are addled or replaced a hen may sit for much longer than the usual period; one hen sat 47 days until a replaced clutch finally hatched. Eggs of the Mongolian race, *P. c. mongolicus*, when placed in the same incubator with those of the two commoner forms were found to hatch about 24 hours later, between 24–25 days.—E. E.

WILLING, R. L. 1958. Feeding habits of Emperor Penguins. Nature, **182**: 194–195.—Use is made of tide cracks and seal holes for feeding and for access to the sea.—H. C. S.

MANAGEMENT AND CONSERVATION

BRUNS, H. 1959. Das Problem der verwilderten Haustauben in den Städten. Biol. Abhandl., **17**: 1–36.—The problem of the feral Domestic Pigeon in cities, and methods of handling it.—E. E.

DEMENTIEV, G. P. 1958. The protection of fauna in the U.S.S.R. Atl. Nat., **14** (1): 11–21.

ELDER, W. H. 1958. A research report on the Hawaiian Goose or Nene. Pan-American Sect., Int. Comm. Bird Pres., Research Rept. no. **3**: 1–8.—Probably the rarest of living waterfowl, the Nene is now believed to number only about 35 in the wild and a somewhat larger number in captivity. Suggestions are made for protection and artificial rearing.—E. E.

INTERNATIONAL COMMITTEE FOR BIRD PRESERVATION. 1958. VII Bulletin of the International Committee for Bird Preservation. 250 pp., 16 photo pls. Price, $2.10, at N. Y. Zool. Soc., Bronx Park, New York 60, N. Y.; or 15s., at Brit. Mus. (Nat. Hist.) Cromwell Road, London S.W. 7, England.—Report of international conferences, 1952–1957, and of bird protection status in various countries having national sections affiliated with the Committee. Articles by different authors on a variety of conservation problems: oil pollution, establishment of refuges on migration routes, need for protection of birds of prey, effect of pesticides on wildlife, gulls as a menace to other species, decrease of the White Stork, and status of various very rare or almost extinct birds, Hawaiian Goose, Laysan Teal, Japanese Crane, Steller's (Short-tailed) Albatross, Cuban Ivory-billed Woodpecker, and certain species in the U.S. Virgin Islands.—E. E.

MEHNER, J. F., and G. F. WALLACE. 1958. Robin populations and insecticides.

Atl. Nat., **14** (1): 4–9.—The heavy use of insecticides to control Dutch Elm disease has caused the almost total destruction of *Turdus migratorius*, and a great reduction in other birds, on the Michigan State University campus and two other areas intensively studied. Robins are poisoned by eating earthworms in which DDT has concentrated by feeding on leaf litter.—E. E.

RIDLEY, M. W., and L. PERCY. 1958. The exploitation of sea birds in Seychelles. Colonial Research Studies, no. 25: 1–78, maps, 34 photo. pls. Price, 12s 6d. Her Majesty's Stationery Office, London W.C. 2, England.—The Seychelles, a group of small islands in the Indian Ocean north of Madagascar, provide nesting sites for many sea birds. About 2,000,000 tern eggs, chiefly of Sooty Terns, are collected and shipped for food, but there has been a steady decline in egg production since 1890 when over 7,000,000 eggs were collected. In 1955, on Desnoeufs Island (of 97 acres) 1,210,000 pairs of Sooties and 18,300 pairs of Common Noddies were estimated to breed. Sooties nest in the dry season after the inception of the southeast monsoon winds. The report contains much life history data on the Sooty and Noddy Terns and some information on the boobies, shearwaters and other birds found on these islands. Experiments indicated that only a proportion, probably not over half, of the Sooties laid a second egg when the first was removed, and that an even smaller number laid a third if the second were taken.—E. E.

MIGRATION AND ORIENTATION

CURRY-LINDAHL, K. 1958. Internal timer and spring migration in an equatorial migrant, the Yellow Wagtail *(Motacilla flava)*. Ark. för Zool., **11**, no. 33: 541–557.—Five races of the *M. flava* complex were found wintering in mixed flocks in the Belgian Congo, near the equator, where light conditions were almost constant. Though subject to the same environmental conditions on the wintering grounds, the various races showed a different timing with respect to molt, fat deposition, gonadal development, and departure on the northern migration. The southern breeding races leave first, the northern last. The internal rhythm seems to be correlated with the climate of the breeding grounds.—E. E.

DORST, J. 1958. Observations ornithologiques à bord des navires météorologiques français dans l'Atlantique nord. L'Oiseau, **28**: 309–323.—Observations of birds from stationary meteorological ships at three points in the North Atlantic.—E. E.

EKLUND, C. R. 1958. A distribution study of the South-Polar Skua. Emu, **58**: 98–100.—In connection with the International Geophysical Year *Catharacta skua maccormicki* has been banded at various Antarctic localities with bands of different colors or combinations of colors. Reports should be sent to the author, USNC IGY, Regional Programs Office, Washington 25, D. C.—E. E.

HINDWOOD, K. A. 1958. The Arctic Tern in Australia. Emu, **58**: 259–263.—Specimens taken in Australia included one banded as a juvenile almost a year before on the White Sea in northwestern Russia.—E. E.

HOFFMAN, K. 1958. Repetition of an experiment on bird orientation. Nature, **181**: 1435–1437.—Matthews' experiment was repeated with opposite results, thus offering no support to sun navigation hypothesis.—H. C. S.

LACK, D. 1958. Migrational drift of birds plotted by radar. Nature, **182**: 221–223.—Course taken by migrants from England to the northeast was a resultant between a constant heading and the wind at the time. Migrational drift must be commonplace since it occurred almost every day and night.—H. C. S.

STORR, G. M. 1958. Migration routes of the Arctic Tern. Emu, **58**: 59–62.—Recent records demonstrate that *Sterna macroura* winters regularly in the zone of Antarctic pack-ice. Occurrences in the southern Indian Ocean and southwest Pacific (the species is not a migrant in the northwest Pacific) probably involve birds carried eastwards from the South Atlantic by the strong winds of the "roaring forties".—E. E.

VOOUS, K. H. 1959. [High flight of migrating duck.] Limosa, **32**: 70.—A duck, apparently a male Mallard, crashed against an airplane at an elevation of 2700 m., on April 2, 1958 at 21.20 h. 40 km. ssw of Frankfort, Germany. (In Dutch; English summary.)—E. E.

WODZICKI, K., and P. STEIN. 1958. Migration and dispersal of New Zealand Gannets. Emu, **58**: 289–312.—The New Zealand bred Australasian Gannet, *Sula bassana serrator*, in its first year migrates westward towards warmer Australian waters, sometimes as much as 4,000 miles. Older birds migrate less, and adults do not seem to be migratory. The North Atlantic Gannet, nominate *bassana*, and the Cape Gannet, *capensis*, also show the longest migrations in first year birds, which respectively go south and north into tropical waters.—E. E.

PHYSIOLOGY

BEAUMARIAGE, M. L. 1958. Inability of epinephrine to protect Rhode Island chicks against the lethal action of X-rays. Nature, **182**: 803–804.

DATTA, R., J. GHOSH, and B. C. GUHA. 1958. Electrophoretic behaviour of avian haemoglobins. Nature, **181**: 1204–1205.—Five haemoglobins were detected from 32 species of 13 orders.—H. C. S.

GLICK, B. 1959. The experimental production of the stress picture with cortisone and the effect of penicillin in young chickens. Ohio Journ. Sci., **59**: 81–86.—Penicillin did not prevent production of stress symptoms.—H. C. S.

HOWELL, T. R. 1959. A field study of temperature regulation in young Least Terns and Common Nighthawks. Wilson Bull., **71**: 19–32.—Young Least Terns *(Sterna albifrons)* and Common Nighthawks *(Chordeiles minor)* were subjected to heat and cold stress in field and laboratory. Young terns regulate body temperature less well at low air temperature but better at high air temperature than gulls of similar age. Young terns may be exposed to sun and high temperatures when not being brooded. Young Nighthawks, which are normally brooded all during the day, showed less temperature regulation.—J. T. T.

LORENZ, F. W. 1958. Carbohydrate metabolism of cock spermatozoa. Nature, **182**: 397–398.—Sperm convert glucose and mannose to fructose.—H. C. S.

MORRIS, T. R., and S. FOX. 1958. Light and sexual maturity in the domestic fowl. Nature, **181**: 1453–1454.—Rate at which a pullet approaches sexual maturity is increased by increasing length of day and decreased by decreasing length of day.—H. C. S.

SCOTHORNE, R. J. 1958. Histochemical study of the nasal (supra-orbital) gland of the duck. Nature, **182**: 732.—The gland is neither serous nor mucous. It contains abundance of mitochondria, rich blood supply, some alkaline phosphatase and is reminiscent of mammalian gastric glands and chloride secreting cells of the gills of euryhaline fish.—H. C. S.

THREADGOLD, L. T. 1958. Photoperiodic response of the House Sparrow, *Passer domesticus*. Nature, **182**: 407–408.—Birds on only one hour of light per day gave testicular response after 4 months of the regime. The minimal threshold

is therefore greatly reduced; photoperiod experiments must be conducted for at least 6 months. Birds on 7 hours of light responded 3 months later. Testis cycle theorized to be under 2 separate mechanisms, one stimulating and one inhibitory. —H. C. S.

Taxonomy and Palaeontology

Berger, A. J. 1959. Leg-muscle formulae and systematics. Wilson Bull., **71**: 93–94.—More muscle formulae than previously used are suggested to increase the utility of these characters in avian systematics.—J. T. T.

Blanc, G. A., and A. C. Blanc. 1958. Bones of a vulture among the remains of animals sacrificed on the "burial of Romulus" below the *Niger lapis* in the Roman Forum. Nature, **182**: 66.—Either *Aegyptus monachus* or *Gyps fulvus*. —H. C. S.

Clancy, P. A. 1959. The Cattle Egret of the Ethiopian Region. Bull. Brit. Orn. Club, **79**: 79–80.—States that in *Ardeola (Bubulcus) ibis* of tropical Africa legs and bill do not become red or purplish in the breeding season, and therefore considers it a distinct subspecies, using Bonaparte's name *ruficrista*. Suggests that American birds may be the African form.—E. E.

Harrington, H. J., and I. C. McKellar. 1958. A radiocarbon date for penguin colonization of Cape Hallett, Antarctica. New Zealand Jour. Geol. and Geoph., **1** (3): 571–576.—Age of frozen Adelie Penguin determined 1, 210 ± 70 years. The rookery was probably colonized between 400 and 700 A.D., about the time of the Northern Hemisphere warm period.—E. E.

Hemming, F. ed., 1959. International Commission on Zoological Nomenclature. Opinion 551. Suppression under the Plenary Powers of the specific name *musicus* Linnaeus, 1758, as published in the combination *Turdus musicus*, and validation under the same Powers of a neotype for *Turdus iliacus* Linnaeus, 1758, the Eurasian Redwing (Class Aves). Op. Decl. Int. Com. Zool. Nomen., 20, pt. 18: 199–210, pl. 1.—*Turdus iliacus* restored as the name of the Redwing. Vaurie's new "The Birds of the Palearctic Fauna" uses *iliacus*, so that name should soon regain general currency.—E. E.

Keast, A. 1957. Variation in the Australian Kingfishers (Aves: Alcedinidae). Rec. Aust. Mus., **24**, no. 7: 61–72.—Taxonomy and distribution of the ten Australian species.—E. E.

Keast, A. 1958. Variation and speciation in the Australian flycatchers. (Aves: Muscicapinae). Rec. Aust. Mus., **24**, no. 8: 73–108.—Generic limits are assessed and some changes made. Maps show variation in many species and the relation between subspecies and habitat. A number of isolated forms are considered as having the potential of becoming species.—E. E.

Keast, A. 1958. Seasonal movements and geographic variations in the Australian Wood-Swallows (Artamidae). Emu, **58**: 207–218.—A taxonomic study, with ecological and migration data.—E. E.

Keast, A. 1958. Infraspecific variation in the Australian finches. Emu, **58**: 219–246.—On taxonomy of the Australian Estrildinae, with useful zoogeographic discussion.—E. E.

Keast, A. 1958. The genus *Psophodes* Vigors and Horsfield, and its significance in demonstrating a possible pathway for the origin of Eyrean species from Bassian ones. Emu, **58**: 247–255.—Taxonomy and zoogeography of the Australian whipbirds.—E. E.

STORR, G. M. 1958. On the classification of the Old World Flycatchers. **Emu, 58:** 277–283.—The author believes that Muscicapidae are not a monophyletic group either when used in the narrow traditional sense or in the broad inclusive sense of Mayr and Amadon (1951). The "typical" flycatchers, *Muscicapa* and its close allies, as well as the Australian robins, he would place in the Turdidae, without subfamilial or tribal distinctions. The monarchs, fantails, and whistlers he regards as each a natural unit, entitled to family rank (Monarchidae, Rhipiduridae, Pachycephalidae). The resemblances between the groups he considers convergence resulting from similar feeding habits, not an indication of common ancestry.—E. E.

VERHEYEN, R. 1958. Notes sur la classification des Procellariiformes (Tubinares). Bull. Inst. Roy. Scien. Nat. Belg., **34**, no. 30: 1–22.—A new classification of the Procellariiformes, recognizing three families, Diomedeidae, Procellariidae, and Hydrobatidae, but removing diving-petrels, Pelecanoididae, from this order to form a suborder of Verheyen's Alciformes. *Pelecanoides* has long been regarded as a prime example of convergence—petrels that in adopting similar diving habits have come to resemble auks superficially. Verheyen contends that they *are* auks, that auks, petrels and penguins all derive from a single flightless stock, with the diving-petrels branching off from the alcids before the latter had greatly diverged from the primitive petrels. Unfortunately nowhere in this paper does Verheyen list the characters on which he claims the Pelecanoididae are nearer to auks than to petrels. (In French.)—E. E.

VERHEYEN, R. 1959. Basic systematics and ornithogeography. Gerfault, **49:** 95–101.—Objecting to subjective judgments, Verheyen urges that taxonomic relationships between birds be based on the percentage "of the total of their taxonomic characters" held in common; *e.g.*, 90% or more the same genus, 80% subfamily, 70% family, 60% suborder, 50% order. This method itself depends on the subjective determination as to what is a taxonomic character and as to whether a structural or behavioral complex should be counted as one or as several "characters." Verheyen criticizes the current reluctance to recognize monotypic taxa as reflecting in part the provincialism of northern systematists, who tend to force little-known southern birds into familiar northern groups. He says that such lumping conceals basic differences of zoogeographical and evolutionary significance. (In English.)—E. E.

MISCELLANEOUS

RICE, D. W. 1959. Birds and aircraft on Midway Islands. 1957–58 investigations. Spec. Sci. Rept.: Wildlife, no. 44: 1–45. U. S. Dept. Int., Fish and Wildl. Serv.—35 per cent of the world's breeding population of Laysan Albatrosses is concentrated on Midway Atoll (chiefly on Sand Island). The rest are on a few Hawaiian islets. The U. S. Navy, which maintains an air station on Midway, has been concerned by strikes of aircraft with flying sea-birds. Though no aircraft have crashed, the hazard would be much greater were jet planes to be used. In a previous report the Fish and Wildlife Service recommended ground levelling near the runways to eliminate the updrafts favored by soaring albatrosses (Kenyon, *et. al.*, Spec. Sci. Rept., no. 38, 1958). The Navy authorities insisted, instead, on an "experimental" killing program during the 1957–58 breeding season. Navy personnel clubbed to death over 30,000 adult albatrosses (chiefly Laysan) and some 21,000 Sooty Terns. Almost all birds nesting near the airstrip were destroyed,

but no noticeable reduction resulted in birds soaring over the runways, because non-breeding individuals replaced those killed. The scanty banding data indicate that these albatrosses do not breed until their seventh or eighth year, though birds begin to return to the colony when between four to six years old. Parents that have reared their single chick may not renest the following year. This report concludes that "no large-scale reduction in numbers would be advisable from the standpoint of perpetuation of these [albatross] species" and recommends ground levelling, pointing out that as to jet aircraft the solution may be an engineering one. [Despite this report, the Navy authorities in August, 1959 announced a decision to extirpate entirely the albatrosses of Sand Island, Midway, by killing all over a period of years. Apparently no sea-bird habitat will be left on the other part of Midway Atoll (Eastern Island), for, according to R. E. Warner (Elepaio, **20**: 19, Sept. 1959), the surface is to be completely paved in connection with the erection of a radio station and even then the area was being bulldozed. A world interest exists in the protection of the Laysan and Black-footed Albatrosses, birds of restricted range and slow reproduction. Surely American engineering ingenuity can work out a more creditable way of handling this problem—even though initially it may involve a greater dollar expenditure.]—E. E.

STRINGHAM, E. 1958. Alexander Wilson. A founder of scientific ornithology. 29 pp. Price, 50 cents. Box 986, Kerrville, Texas.

LETTER TO THE EDITOR

Supposed Cannibalism by Short-eared Owls

May I point out that it can be too readily assumed that owlets which disappear from the nests of Short-eared Owls *(Asio flammeus)* have been devoured by their nestmates. It is not unusual for the owlets to crawl out of the nest and secrete themselves some distance away. (See Armstrong and Phillips. 1925. *Notes on the nesting of the Short-eared Owl in Yorkshire.* British Birds, **18**: 226–230). This may be particularly likely to occur when a human being has visited the nest. Cannibalism in this species should not be assumed to be "of frequent occurrence" until better evidence is available than is cited by Mr. Collingwood Ingram in his recent paper (Auk, **76** (2): 222–226, 1959).—EDWARD A. ARMSTRONG, *St. Mark's Vicarage, Cambridge, England.*

NOTES AND NEWS

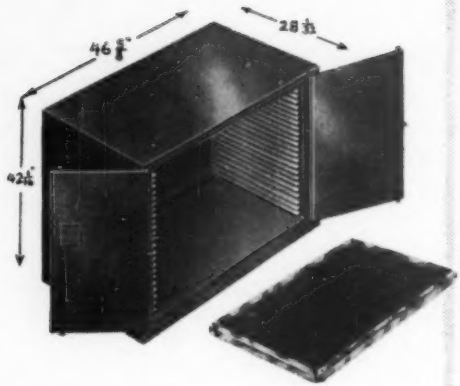
Notice of Change of Editor

All manuscripts and communications intended for 'The Auk' and books to be reviewed should be sent to the new Editor, who will be responsible for volume 77 (1960): DR. DONALD S. FARNER, *Laboratories of Zoophysiology, Department of Zoology, Washington State University, Pullman, Washington.*

The retiring Editor thanks the numerous ornithologists who helped, whether in appraising manuscripts or in other ways, not least of whom were the authors who showed understanding (or at least forbearance) when pressed with suggestions for change.

International Commission on Zoological Nomenclature

The new address of the International Commission on Zoological Nomenclature is c/o British Museum (Natural History), Cromwell Road, London S.W.7, England. Telephone: KEnsington 6323. Ext. 187.



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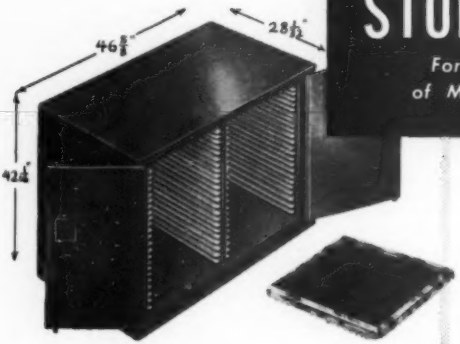

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